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Water flowing through industrial facilities, the governance of an illusive abundance

Insights from the cases of Port-Jérôme and the Lyon Chemical Valley

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Abstract

Industrial water use in France has long followed a paradigm of abundance. Climate change now starkly reveals the vulnerability of this resource. In response, regulators have promoted decreased industrial water use through "hydric sufficiency". This aim is, however, challenged by another political priority: reindustrialization, which risks intensifying water pressures. Understanding industrial water governance, an understudied topic, appears more than urgent. Through a cross-case qualitative analysis of two industrial complexes —Port-Jérôme and the Lyon Chemical Valley—this research examines how industrial water governance is configured, but also transformed by these political pressures. Industrial water governance reveals itself to be a complex system, amid actor profusion across scales. The production of data and a shared diagnosis emerge as pivotal steps in this governance. This step sets the stage in which French rivers are still framed as sources of abundant water flows. Furthermore, the analysis of industrial regulation reveals internal tensions and limitations in preserving water within industrial uses. This thesis unpacks these dynamics favorable to industrial development, particularly revealed in cases of drinking water pollution. Hydric transition, far from resolving these tensions, further reinforces them. By dissecting the narrative apparatus that underpins current reforms, this thesis nuances the depth of industrial transformation and exposes the depoliticization of water preservation under the guise of reindustrialization.

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Introduction

"When water is abundant, we don't think about saving it. But when it starts running out, our perspective changes. I believe we're at the early stages of this shift. In Normandie, for instance, water was so plentiful that we never really had to question our usage. But after several consecutive years of drought, we're now being forced to rethink both our consumption and how we use this resource."

— Interview with a facilitator of the SAGE Commerce, Port-Jérôme, Normandie

These words reflect the renewed attention to water governance in France. As the resource declines, the interviewee calls for moving beyond the paradigm of water abundance. Decades of over-extraction have degraded water, and the effects are now exacerbated by climate change (Perrot and Pilato, 2023). Climate change alters hydrological patterns — such as glaciers melting, increased frequency of droughts and floods, reduced river flows, and shifting rainfall — further threatening water quality and aquatic biodiversity (ibid.). It generates social and economic tensions over water use, particularly during shortages (Berne, 2023). France is among the European countries most affected by climate change, with significant territorial disparities (Dantec and Roux, 2019; Réseau Action Climat and ADEME, 2024) and one of the countries with the most surface waters under pressure within the European Union (European Environment Agency, 2024, p. 41). These pressures became particularly visible during the 2022 drought, which affected the entire country and disrupted all water uses (Berne, 2023). As a result, the longstanding paradigm of water abundance that used to shape French water governance is now being challenged. What happens when water begins to run out, and its uses must be planned to ensure provision? In response to water depletion and growing tensions among users, French President Emmanuel Macron announced the Water Plan in 2023, introducing a new concept: "hydric sufficiency". The plan aims to reduce water withdrawals by 10% by 2030, with reductions distributed across all sectors — domestic, agricultural, and industrial. This thesis focuses on industrial water governance. It analyzes its unfolding and its evolutions under the pressures of climate change and economic development. I consider water as a particular good to be governed, as I shall expand on below.

Analyzing water governance requires understanding that water is a natural resource unlike others. It is not a "global bad" pool (Muller, 2015, 685), such as carbon emissions that mainly act as polluting agents. Water for its part, is simultaneously a resource and a repository for pollutants. These two aspects must be handled together by authorities. Water is not a single global pool resource either (*ibid*.). While carbon emissions happen at the global scale and soil management at a localized scale, watersheds are the physical scale of water. In the watershed, various hydrological and social interconnectivities develop (Molle, 2011). Water is found on the surface and beneath. Rivers replenish aquifers, while groundwater sustains base flows during dry periods. Wetlands regulate streamflow as they store and release water, acting as natural filters. These dimensions of water are usually expressed in terms of quantity (scarcity or excess of water), quality (chemical composition or thermal properties[1]) and hydromorphology (flow rates, ecological continuity, and the

[1] In industrial processes or energy production water can be used as a coolant in processes. As a consequence, the water discharged can be warmer. This can disrupt aquatic ecosystems, notably by modifying the availability of oxygen for species.

morphology of watercourses). They cannot be dissociated in water management. As an example, water flows facilitate the leaching of soils and roads while low-flow periods lead to higher contaminant concentrations due to reduced water volume (Berne, 2024). Water's hydrology creates a physical anchorage, i.e., spaces and uses are interconnected in the watershed. As water flows through the watershed, the hydrological cycle connects individuals, upstream and downstream, from one river bank to another. Use by one affects the others. Water is therefore often considered a common-pool resource, where excluding users becomes difficult when rivalry over use emerges (Barraqué, 2021). This notion extends beyond this technical definition. This "common[2]" resource has a political meaning, it evokes a particular way of relating to the world, to others, and to property (Paquerot, 2017). However, the "common" is subject to privatization and struggles for appropriation within the watershed. As actors proliferate, interest may diverge or conflict.

These hydro-social particularities have implications for water governance by public authorities, and thus its uses by industrial actors. Multiple scales cohabit: large planning-decisions are taken at the European and national scales, the decentralized state services implement them at the regional and departmental levels. Municipalities and metropolitan areas also intervene at the local level. A hydrological boundary logic comes to layer with the administrative one. Watersheds are dotted with their own governance mechanisms. This system triggers vertical and horizontal coordination issues among public actors (OECD, 2021). The French system displays multiple autonomous centers of decisions, with overlapping and shared responsibilities (Baldwin *et al.,* 2018; Pahl-Wostl and Knieper, 2014). By "centers", I mean a variety of entities, an individual or a collective, representing public, private, and civil society actors (Thiel et al., 2023). In that instance, the French water governance system can be considered as a case of polycentric governance.

My analysis of industrial water governance is set in that complex polycentric system, creating hydro-social connections. In total, 37 semi-structured interviews have been conducted with actors belonging to multiple layers of governance, gathering public authorities, economic actors, experts, and the civil society. I selected two industrial complexes as case studies[3]: Port-Jérôme in Normandie and the Chemical Valley in the Auvergne-Rhône-Alpes region.

[2] The notion of "commons" and "common pool resource" will be further detailed in the literature review.

[3] I adopt a broad definition of industrial complexes as geographically bounded areas that concentrate a significant number of industrial activities. Additionally, Port-Jérôme and the Chemical are both shaped by physical proximity and by institutional and infrastructural interdependencies. I also acknowledge that there are differences among industrial sites regarding industrial water use. It depends, among others, on their activity, their history, their location, or on their internal policies. However, I found in my research that the stakes of industrial water governance are shared among this large

The Chemical Valley and Port-Jérôme, like all industrial complexes, are dependent on water. Historically, industries have been established along rivers and waterways to ensure proximity with this essential resource (Berhemont, 1999). Water serves four main functions in industrial processes: thermal fluid (for steam production and cooling systems); raw material in manufacturing; washing agent; to meet the needs of on-site personnel (Roustan and Grasmick, 2015)[4]. Water is also a source of dilution for industrial production, as it reduces the concentration of pollutants or waste in effluents before discharge. Water takes the form of a risk for industrial areas, whether through its lack (drought) or its excess (flood). These uses, coupled with hydro-social interconnectivities, allow me to capture five main dimensions of water to tackle industrial water uses: water as a resource consumed for industrial uses; water as an effluent absorber; water as a risk (flooding, drought); water as a habitat, for biodiversity: an ecosystem in which biodiversity may thrive; and water as a resource to be shared among different users.

The use of water in the industry, like all natural resources, retains a certain paradox: while it is a much-needed resource, industries have participated - alongside other uses - to the degradation of the resource. Historically, industrialization has led to river modifications, ecosystem degradation, and pollution, with long-lasting consequences (Fisson, 2017). Many of these historical uses still impact water bodies today (*ibid*.). Current uses also burden water bodies, whether through water abstraction or through pollution (chronic or accidental). The case of the Chemical Valley will highlight – with the PFAS case – the permanence of challenges in industrial pollution.

In spite of these effects, interviewees – and especially industrialists and their representatives - often pointed out the relatively limited effects of industrial activity on water. Nationwide, relatively to other uses, the industry represents a limited share of water abstraction and consumption. This activity account for 9% (including construction) of water withdrawals[5], which is lower than the energy sector (14%) and far below

typology of actors. This is especially true as they abide by the same categories of regulation. I will thus study in this master's thesis how water is governed in and for this typology of actors as a whole.

[4] Water is also a vector of mobility, but this is not a dimension I will study in that master's thesis.

[5] Water withdrawal (or abstraction) and water consumption correspond to two distinct measures. Water withdrawal refers to the total amount of water taken from a source (such as a river, lake, or aquifer) for use. Water consumption, on the other hand, refers to the portion of the withdrawn water that is not returned to the source, typically because it has evaporated, been incorporated into products, or been lost to the immediate water cycle. For example, a power plant withdraws 100 million liters of water from a river for cooling purposes. After use, it returns 95 million liters to the river. The remaining 5 million liters evaporate during the cooling process. In this case, the water withdrawal is 100 million liters, while the water consumption is 5 million liters.

agriculture (62%) (Arambourou *et al.,* 2024). Industrial decline, improvements in processes and practices, and stricter regulations have led to significant reductions in both water consumption and pollution since the 1990s (*ibid*.). Yet, 9% of national water consumption remains significant—equivalent to 2.3 billion cubic meters per year. When looking at water withdrawals rather than consumption, industry alters river hydromorphology (flow rates, water movement) at levels comparable to other sectors: industry accounts for 8% of annual withdrawals, compared to 11% for agriculture and 14% for domestic use (*ibid*.). Furthermore, national averages do not reflect localized pressures exerted by industry in heavily industrialized areas (European Environment Agency, 2024, page 75), nor do they account for seasonal variations—especially during low-water periods when availability is at its lowest.

The stakes that water poses for industrial production are reinforced by the current context of reindustrialization. From the 1970s, France faced a wave of massive deindustrialization, with a sharp decrease in GDP and industrial employment (La Fabrique de l'Industrie, 2024). In the past decade, policymakers have embraced reindustrialization as a strategy for job creation, industrial autonomy, and energy security. It involves supporting existing industries but also the installation of new ones on national territory. This does not go without impact on vulnerable water bodies. Decreases in industrial pressures on water are partly explained by deindustrialization (Legrand, 2024). In that regard, the development of new industrial projects leads to increased water consumption by this sector (*ibid*.) How can we combine the Water Plan's hydric sufficiency demanding decrease in water abstraction and the increased water needs involved by reindustrialization? How can we shift from the abundance paradigm when this national priority requires more water? These dilemmas are even more crucial given that reindustrialization is often framed as a "green" initiative, aimed at fostering an ecological transition—both within the industrial sector itself and by producing goods necessary for the broader green transition (Guitton-Boussion, 2023; Bonnefous, 2023). The design of this green industry does not seem to account accurately for the water resource preservation question. The "Green Industry Law"[6] displays only one measure dealing with pressure on natural resources. It is criticized for the limited sufficiency efforts encouraged in industrial production and resource consumption (Legrand and Bourgeaux, 2023).

[6] Law n° 2023-973, October 23rd 2023

Just as the abundance of water is being called into question and appeals to "hydric sufficiency" are multiplying, a new wave of reindustrialization is underway. How can hydric sufficiency be implemented in a context where water resources are diminishing and increasingly strained by industrial revival?

Research Question

Anchored in these tensions, and through the studies of Port-Jérôme and the Chemical Valley, the following research question will guide my research:

> How is water governed for industrial uses, given that it is a common good at the center of hydro-social interconnections, and how does this governance evolve under the dual political pressures of green transitions and economic development goals?

It involves three underlying puzzles:

How can water be governed through conflicting agendas involved by its physical interconnectivities? Water, due to the interconnections it entails, constitutes a particularly complex resource to govern. It implies polycentric arrangements involving multiple levels of decision-making. It is, simultaneously, a resource and a pollutant repository, and must also be shared with other users. It calls to question the power relations unfolding in the decision-making process.

How do governance arrangements cope with inevitable knowledge gaps and uncertainty? Water's governance is further complicated by its physical uncertainties. It places knowledge production and circulation at the core of environmental policy debates. Knowledge becomes a vector of power, in the design and implementation of policies. It creates tensions between the technical and socio-political dimensions of water.

How do political shifts (green vs. industrial) reshape industrial water governance? As the balance shifts between political priorities such as reindustrialization and ecological transition, stakeholders navigate tradeoffs between these two dimensions. As hydric sufficiency calls for change in practices, it calls to question the extent and depth of change of the practices and governance regime.

Literature review and theoretical approach

This literature review seeks to situate and discuss industrial water governance as a polycentric process, discussing its functioning and change in the dual pressures of economic and environmental goals.

It is structured in three parts. First, I will expand on how my research departs from the materialization of water interconnectivities, and how they shape the governance realm. Second, I will discuss the relevance of environmental governance studies in studying two critical themes in my research: the regulation of industrial uses, and green transitions pathways. Third, I will argue that these themes can be studied through a sociology of public action perspective, resorting particularly to the policy instrumentation perspective.

Water governance: getting hold of a particular good

The notion of water as a "common pool resource" sets the stage of my analysis. Developed by Ostrom (1990), it explicates the possible tensions that may arise when using water, a resource that is rival (the use by one actor reduces the availability for another) and non-excludable (it is difficult to exclude one actor from using the resource). Later approaches extend this concept, by addressing both water quantity and quality (Suhardiman *et al.*, 2017). This notion of common good unveils both the particularities of water and its impacts on governance.

The watershed: from physical interconnectivities to polycentric governance

Water is – as studied in the field of political ecology and STS – both a social and environmental object. The materiality of water is at the roots of interconnectivities within and between these worlds, which is captured through the notions of hydro-social or socio-environmental (Swyngedouw, 1999; Molle, 2010; Paquerot, 2017). This notion of materialization is relevant to explain my choice of the territorial scale to study my cases. It also puts at the forefront themes I shall discuss extensively: knowledge and governance.

Regarding knowledge, a material perspective underlines both the physical uncertainties that lie behind the hydrological processes but also their interactions with the social world (Molle; 2010). The production of data on water, whilst stabilizing inherent uncertainties, abides by similar logics of hydro-social hybridizations (Jasanoff, 1999). Knowledge production and appropriation become a political topic (Bouleau and Fernandez, 2012).

The material approach to water also has implications in hydro-social governance (Trottier, 2023). Interconnectivities link water to the social, and social groups within themselves. The watershed becomes a social shed (Snyder, 2020; Moretti, 2021). In the watershed, multiple actors coexist, with various uses, interests and representations of water (Grimonprez, 2022) that have political and power-based implications in the management of the resource (Swyngedouw, 1999; De Jong *et al.,* 2024). This is also where "usage conflict" has its roots, in open or latent forms (Calvo-Mendieta, 2015). This ties back to water not being a "global bad" pool (Muller, 2015, p.685). Water creates dependency among users and scales in the watershed. These material implications of water play out in water governance.

The French water governance system: grappling with an interconnected object

How does the French Water Governance system – the framework of my study – grapple with the complexities of water interconnectivities? Scholars at the crossroads of political science, sociology, and history have grappled with those themes.

The roots of the French water governance model lie in the 1964 Water Law. By institutionalizing the watershed as the governance scale, it acknowledges the political coherence of that hydric perimeter. This watershed level governance for water is now widespread (Davidson and de Loë, 2014). Layering with this institutionalized hydric logic, administrative scales emerge. This is particularly reinforced in my case, where industrial water management is – as I shall expand on – mainly ruled by the DREAL, a decentralized state service. Alongside those different scales, a central-local tension emerges, especially in France, a country with a record of centralizing tendencies (Larrue, 2002). In the 1980s, the state-led decentralization translated into water governance (Larrue, 2002; Ghiotti, 2006; Barreteau *et al.,* 2016). In parallel, the European scale has become increasingly significant in water policy (Larrue, 2002). This layered system results in an institutional complexity of water policies, fragmented among instruments and actors at all scales (Barone and Mayaux, 2019). As it stands, the French system relies on a polycentric governance system[7] (*ibid*.). This can be emphasized by the multiple decision centers coexisting, and the cross-sectoral characteristic of water in France (Salvetti and Canneva, 2017; Barone, 2025). The notion of polycentricity – as coined by Vincent and Elinor Ostrom - often refers to a "normative" approach, i.e., what is the best way to govern a given resource (Schröder, 2018). In my case, I refrain from adopting such normative vision on the concept. The concept of polycentricity helps me set the stage of my study, accounting for the interdependence of a multiplicity of

[7] As mentioned before, "polycentric" refers to a system that displays multiple autonomous centers of decisions, with overlapping and shared responsibilities (Baldwin et al., 2018; Pahl-Wostl and Knieper, 2014).

actors between and across scales. Polycentricity captures the complexity of the French water governance system, distributed among various layers. It justifies the contributions of my master's thesis. Local and historical dynamics in the unfolding of collective action on water have been limited (Calvo-Mendieta, 2015). Through my analysis, I bring attention to the territorial dynamic and its relation with other layers of governance.

The French model is particular for its integration of "solidarity" in the 1964 law (Carré and Markovitch, 2024). This concept enacts the mutualization of resources at the horizontal level, among users. It consists of three dimensions (*ibid*.): hydrographic solidarity (water management is conducted at the watershed scale, transcending administrative boundaries), financial solidarity (all users, including industries, contribute financially to water preservation) and territorial solidarity (financial solidarity mechanisms are enacted between larger urban areas and smaller rural towns). This notion of solidarity is important in my research for two reasons. First, this principle founds and explains the French water governance system, and notably its consultative character (Richard and Rieu, 2008). End users are called to participate in instances, and to enact fees that should be redistributed among users. Second, the notion of solidarity is appropriated by water users, as it was mentioned frequently by interviewees. The public actors interviewed are cautious about this solidarity in applying regulations. They seek to share the burden among users. Industrialists also mobilize this register, notably on the question of financial solidarity in water policies (Marette *et al.*, 2006; Barbier *et a*l., 2007). They describe a system that disproportionately burdens them. It is however assessed that they do not fully bear the costs of their externalities (Salvetti, 2024). Distributive justice questions arise. As the fees are determined in consultative instances, it interrogates the stakeholders' ability to engage with policy co-construction in dedicated arenas. The consultation in water instances is criticized for privileging specialized actors, such as industry representatives, over non-specialists (Barraqué, 1995). The discussions – through a technical prism – exclude some stakeholders from discussions, and notably the civil society (Li, 2007; Barreteau *et al.*, 2020; Vergote and Petit, 2016). It involves power dynamics and justice questions, themes that have received limited attention within comparative studies on water governance (Özerol *et al.,* 2018). With the lens of industrial water governance, I will contribute to bridging this gap.

Industrialists within water governance:

If water governance in France is to be understood through a polycentric dynamic, why should I focus on the industrialists, a subset of actors? Studies on the French water governance realm often incorporate industrialists among other users. To understand this polycentric model, this focus is relevant. It displays how water governance rules play out in a particular context. It reveals the role of actors that are not usually central, such

as the DREAL inspection services that will be central in that study[8]. Doing so, I will participate in connecting literature on industrial environmental governance and water governance. I will also fill an empirical gap. Several academic productions cover specifically agricultural uses, or municipal water provision. For industrial water governance, I could not encounter social science production that deals directly with that topic in the French landscape. The relevance of studying industrial water governance is further reminded by the dual context of water preservation and reindustrialization.

The field of water governance studies – at the crossroads of various disciplines - sets the stage for the interactions I observe in the case of industrial water governance. To complete this approach, I shall now dive into environmental sociology.

Environmental governance, balancing economic and environmental

Studying industrial water governance calls to grapple with a well-studied question in social sciences: the tradeoffs between economic development and environmental protection. It is acknowledged that the latter is far from being the first goal of public policy. Instead, it is about striking the balance between the environment and other domains, notably economic development (Lascoumes 1994, p. 18). Water policies abide by the same logic (Barone, 2025). This central frame is prominent in the master's thesis, and deserves to be further explained under two lenses: environmental regulations and sustainable transition pathways.

Governing and regulating industrial uses

Environmental regulation revolves around three main forms of instruments: command and control, incentive or marker-based approaches, and voluntary approaches (Lo *et al.,* 2020, p. 593). In the past thirty years, there has been a shift from regulating private actors towards incentive-based and voluntary approaches (*ibid*.). It went hand-in-hand with an increased involvement of industrialists in the enactment of regulatory activities: regulatory frameworks require industrial actors to produce documents assessing the risks of their activities, such as impact studies (Boullet, 2012). Several scholars emphasize the historical continuities and the

[8] The DREAL is a regional decentralized state service. One of their departments is responsible for industrial policy implementation. In this master's thesis, DREAL refers specifically to this service, of which the critical role in water governance will be studied.

persistence in this increased self-governance of industrialists (Fressoz, 2011; Bécot, 2020; Le Roux, 2021). What are the implications of this self-governance for environmental governance?

The proponents of incentive-based and voluntary approaches highlight the cost efficiency of self-regulation (Lo *et al.,* 2020). Yet, the extent to which they are efficient, particularly for sustainability, has been questioned (Boiral, 2007). Looking at market mechanisms first: it has been widely acknowledged that the application of the polluter-pays principles does not compensate rightly for the damage caused (Howarth, 2009; Sanchez Tranchon and Lefaive, 2024). Likewise, voluntary standards have shown their limits. Some studies of multi-national sustainability reporting demonstrate that neither the techniques nor the ethical objectives are matched, notably due to methodological mismatch and simplifications (Vigneau et Adams, 2023, p.867). Some scholars analyze self-regulation as further exclusion of the civil society (Noel *et al*., 2016; Vigneau and Adams, 2023; Le Naour, 2024). Furthermore, this system revamps the state's role. While it is described for some as a retreat, others defend it as a renegotiation (Borraz, 2007). The state agents are posited as partners to industrialists, though they retain a regulatory role (Sanseverino-Godfrin, 2015; Bonnaud, 2011; Brunier and Pilmis, 2020).

Transitions pathways: policy inertia, path dependency, depoliticization

Green transitions are another theme of environmental governance where tensions emerge. How can we balance environmental and economic goals? What are the paths to transitions, and the extent of transformation towards a sustainable society? As I engage in a discussion on the change in industrial water use practices, this literature is crucial.

To answer these questions, we need to apply the notions of weak and strong sustainability, and ecological modernization (Hajer, 1995). Developed in the 1980s, this framework - initially focused on firms' strategies - challenged the prevailing view that environmental issues were separate from political, economic, and social concerns. It emphasizes the role of technology-based solutions and promotes the idea that environmental protection can create win-win situations without penalizing economic actors (Béal, 2016). Since then, this conceptualization has influenced public action in the environmental domain (*ibid*.). It also contributed to a shift in state intervention, favoring reduced regulation and a more hands-off approach (Blowers, 2000). The win-win situation can even be referred to as a triple-win of environment, jobs and corporate profit (Anantharaman, 2023, p.140). Building on it for the case of reindustrialization and improved water use, it manifests as follows: environmental benefit (in our case, reducing pressures on water); social benefit (the industry supporting local employment and wealth) and economic wins (as industries could further their development and increase profitability). Several critiques have been directed at this perspective. Claims point

to its overlooking of power dynamics and inequalities in environmental management (Fressoz, 2011; Bécot and Le Naour, 2023; Anantharaman, 2023). Others highlight how these win-win solutions depoliticize environmental issues (Swyngedouw, 2018) and impose a technocratic vision that privileges official expertise and marginalizes alternative ones (Hajer, 1995). It also calls to question how technology and efficiency can represent a solution to climate challenges, a vision challenged by the literature (Davidson, 2019; Lorek and Fuchs, 2013). These debates will prove critical in the master's thesis. Does hydric sufficiency induce a change in practices towards more sustainability, or does it sustain the *status quo* (Hölscher et al., 2018)? As a consequence, it questions growth-oriented narratives, and the lock-ins they create to sustainability pathways (Shove, 2018; Feola, 2021; Barone, 2025).

An anchorage in policy instrumentation

Eventually, all themes and disciplines I evoked can be treated through the lens of the sociology of public action. Within that field, I shall particularly resort to the lens of policy instrumentation. I find it relevant as the instruments materialize implicit political theorization (Lascoumes and Le Galès, 2007), with its associated conflicts and resistances (Le Bourhis and Lascoumes, 2014). I do not exclude resorting to STS and political ecology. I shall mention that these associations are not new, as several authors working on water governance and policy instrumentation follow a similar path (Barbier *et al.,* 2010; Bouleau and Fernandez, 2012; Vergote and Petit; 2016).

The policy instruments are all over in both of my fieldworks, under the forms of regulations, but also shaped as techniques or tools (e.g., thresholds to limit the intakes and emissions values). I find three reasons for which the policy instrumentations are relevant to my study. First, as implicit political theorization, they reveal the actor's behavior but also the effects of power dynamics. (Lascoumes and Le Galès, 2007, p.8). Second, they allow us to analyze the problematization of a public policy problem (*ibid*.), connecting the policy instruments approach with analyses of problem framing (Gusfield, 1981; Gilbert and Henry, 2012). In this master's thesis, this notion of how instruments provide a certain problematization of industrial water use by actors will be critical. Third, the analysis of their instruments allows one to trace the extent of change in public policy, discussing its extent through an analysis of instruments (Halpern and Le Galès, 2011, Halpern *et al.,* 2022).

Conclusion

I introduced in this literature review the main fields and concepts I shall resort to when discussing the themes of industrial water governance: water governance and environmental governance. Theoretically, I situate my research within the sociology of public action, even though I do not exclude resorting to other fields, necessary to understand the material anchorage of water.

This master's thesis addresses several gaps. In water governance, I shall contribute to fields that have had limited publications: territorial approaches to water governance, and attention to power and distributive justice in polycentric systems. On the empirical side, I bridge a gap on industrial water governance, as I could not find any publications studying it in France. . Additionally, Port-Jérôme and Lyon have not been objects of sociological research on water governance, neither on their own nor comparatively. By investigating these underexplored aspects, this research sheds light on how industries navigate evolving water constraints within multi-level governance frameworks in the context of changing political priorities.

Case introduction: industrial water governance in two distinct sites

This section is dedicated to presenting the context of the research, necessary to understand the analysis. I will first introduce briefly the general industrial water governance system, and then expand on the context of each industrial site studied[9].

Industrial water governance: evolving in a dual system

A double logic rules industrial water uses in France. On the one hand, it is regulated through the wider water governance system that applies to all users, implemented by the water institutions. On the other hand, it abides by regulations specific to industrial users, implemented by the decentralized state services.

The French water governance system

French water policy is largely shaped by the European Water Framework Directive (WFD). It sets the goal of a "good status" of the water body in terms of quality and quantity. In France, these goals are implemented by

[9] A more detailed introduction of each site, as well as some visual representations can be found in annex 3

the water agency, at the river basin scale[10]. Water agencies implement a system of usage fees to fund water management and pollution control. They also have a role in incentivizing sustainable practices. The financing system is based on the principles of "water pays for water" and "polluter/user pays," ensuring that revenue from water users funds preservation efforts. Industrial actors have to pay yearly usage fees depending on the amount of water consumed, and the weight of pollutants discharged in the water. The implementation of usage fees involves a consultation through river basin committees[11]. In that instance, representatives of the government, local authorities, economic users, and civil society negotiate financial contributions and policy priorities. A SDAGE[12] is voted every 6 years. It is a planification document that guides water policy at the river basin level and retains legal implications.

At the watershed level, water planning can be further structured through local water management schemes, known as the SAGE[13]. It can be developed if a local water commission[14] is formed, where local end-users are represented, alongside state and local government representatives. The SAGE is a local planning tool derived from the river basin guiding document, the SDAGE. It outlines water management goals at the watershed level and includes enforceable rules, notably for local planification documents (Gest'eau, *n.d.)*.

France's decentralized and territorialized water governance involves multiple actors, including regional and local authorities, that face evolving responsibilities under legal reforms.[15.]

Specific regulations applying to industrial uses

The regulation of industrial water uses steams from the European and national levels[16], with some territorialized tools that complement them. In France, the industries whose activities could present a risk for

[10] I will make the distinction here between the river basin and the watershed. The river basin is understood as the largest hydrographic unit around the river. There are six in France. My study targets two of them: the Seine-Normandie River Basin and the Rhône-Méditerranée River Basin. The watershed is understood as one of the smaller hydrographic units that composes the watershed. I will study the Commerce watershed for the case of Port-Jérôme here.

[11] River basin committees translate in French as "C*omités de bassin*"

[12] SDAGE means "*Schéma Directeur d'Aménagement et de Gestion des Eaux*" (SDAGE). It translates as "Water Development and Management Master Plan".

[13] SAGE means "*Schéma d'Aménagement et de Gestion des Eaux*" (SAGE). It translates as "Local Water Development and Management Scheme".

[14] "Local Water Commission" translates in French as "*Commission Locale de l'Eau*"

[15] See annex 3 for a detailed representation of the French water governance system.

[16] The main EU regulations that target industrial water uses are the following: REACH regulations (chemical use authorizations); the Industrial Emissions Directive (pollution prevention and control requirements for large industrial installations to minimize emissions to air, water, and land); Seveso III Directive (prevention of chemical accidents by the regulation of hazardous substances handling).

the environment are known as Classified Installations for Environmental Protection (ICPE)[17]. The Environmental Code gathers their subsequent regulations. Their implementation of these regulations is conducted by a dedicated unit of the regional decentralized state services, the DREAL[18]. The DREAL is tasked with the examination and authorization for industrial installations. They also conduct control to assess the compliance of industries with the regulation[19]. In case of non-compliance, they can impose administrative sanctions (e.g., formal notice, administrative fine or penalty). The DREAL operates under the authority of the regional prefect. Each DREAL can also develop territorial tools.

Other decentralized state services can also play a part. The regional health agency[20] can be involved when it comes to industrial activities that relate to health and drinking water provision. At the departmental level, the departmental directorate for territories[21] also supports some relevant missions (i.e., it supports the DREAL in some tasks, and holds departmental committees on water management). It is also at the departmental scale that consultative instances are held on industrial installations[22]. The department prefect presides the industrial local monitoring committees as well[23]. These local instances gather different actors (industrial representatives, state services, local governments, local associations and sometimes external experts) and is a place where industrial activity is discussed.

The Chemical Valley

The Chemical Valley is an industrial site located to the south of Lyon, in the Auvergne-Rhône-Alpes region of France. In addition to long term concerns on the Rhône water flows, the current stakes regarding water revolve around industrial pollution by PFAS.

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[17] ICPE stands for "*Installation classée pour la protection de l'environnement"* (ICPE). It means "Classified Installations for Environmental Protection" In this master's thesis, only industries classified as ICPE are considered.

[18] In this thesis, DREAL only refers to the subset of the directorate dealing with the surveillance of industrial activities. DREAL means "*Direction régionale de l'Environnement, de l'Aménagement et du Logement"*. It translates as "Regional Directorate for Environment, Development and Housing".

[19] This control of industries is conducted in the field by DREAL inspectors. Each industrial unit is attributed a given inspector.

[20] The regional health agency translates in French as "*Agence Régionale de Santé*" (ARS).

[21] The departmental directorate for territories translates in French as "*Direction départementale des Territoires*" (DDT)

[22] They are named "CODERST", meaning "*Conseil Départemental de l'Environnement et des Risques Sanitaires et Technologiques*". It translates as Departmental Council for the Environment and Health and Technological Risks.

[23] Site monitoring committees are called in French "*commissions de suivi de site (CSS)*".

Territorial and Socio-Historical Context

The foundation of the Chemical Valley dates to the 1850s. Currently, the industrial site stretches from Lyon to Givors, downstream from the Rhône and Saône confluence. On 1,100 hectares, it covers 14 cities (including 9 in the Grand Lyon metropolitan area), corresponding to 100,000 inhabitants (AMARIS, 2020). The economic activity employs 50,000 people (*ibid*). It consists of 10 sites considered to present high risks, known as Seveso[24] (*ibid*.).

After a wave of deindustrialization, the Chemical Valley has bounced back since the 2010s (Arab and Crague, 2023). In addition to its traditional chemical and petrochemical activity, the industrial complex's activity was oriented towards the "chemical-energy-environment sector" (*ibid*.). Doing so, it aligned with a green reindustrialization dynamic.

Industry and the waterscape

The Chemical Valley is mainly supplied by water from the Rhône River, the French river with the largest waterflow. From the 19th century onwards, the Rhône faced a large artificialization to favor economic development, and notably electricity production (SMIRIL*, n.d*.). The current developments of the Chemical Valley do not seem to threaten a further artificialization of the river, since it relies mainly on a land intensification strategy.

So far, the Rhône water flows have preserved the industrial complex from the effects of drought. However, hydrological disruption linked to climate change are planned to have effects on the quantity of water available in the river (Agence de l'eau Rhône Méditerranée Corse, 2014; Agence de l'eau Rhône Méditerranée Corse, 2023).

Regarding water quality, industrial pollution persists, despite improvements in the past decade (Eau France, 2018, p.48; Agence de l'eau Rhône Méditerranée Corse, 2022, p.115). The PFAS scandal that broke out in 2022 brought the quality question back on the front stage. PFAS (Per-and Polyfluoroalkyl Substances) cover over 4,000 synthetic chemical compounds. Long unregulated, they have been used in a variety of industrial processes and consumer goods since the 1950s. PFAS are known for their effects on human health[25] and their environmental persistence (ARS Rhône-Alpes, 2025). They earn the name "forever chemicals"

[24] A Seveso site is an industrial facility classified under the European Union's Seveso Directive. It aims to prevent major industrial accidents, through the application of stricter rules to sites that store or use hazardous substances above certain thresholds.

[25] Proven impacts include cancer risks, reduced birth weight, and immune dysfunction (ARS Rhône-Alpes, 2025)

(*ibid*.). Two industrial sites of the Chemical Valley, Arkema and Daikin, have been singled out for heavy use. Downstream from Lyon, the Ternay water withdrawal site shows particularly high PFAS levels, affecting the drinking water provision of several cities.

Governing industrial water uses

The governance of industrial water in the Chemical Valley follows the French traditional structure. Industrial activity in the Chemical Valley is overseen by regional (DREAL Auvergne-Rhône-Alpes) and departmental (Rhône) authorities, and falls under the Rhône-Méditerranée-Corse Water Agency[26]. At the Rhône Level, the National Rhône Company is a prominent actor for economic development and hydroelectricity provision[27]. No local water planification instrument (SAGE) covers the area.

The Grand Lyon is the lowest administrative level aligned with the valley's hydrological scale. The water department is responsible for drinking water provision. The polluted Ternay water withdrawal site is part of the drinking water resources managed by the metropolitan area. Other public actors can intervene in water governance (i.e., cities, and environmental associations), as well as scientific actors.

At the industrial level, companies engage directly with regulation and internal processes. They are represented by regional industrial associations and federations. Seven R&D centers operate in the area. No mutualization system for water provision exists. A study (named DECLYC) is ongoing on the potential for water saving and industrial water synergies.

The civil society also participates in industrial water governance through different participatory instances. In response to PFAS pollution, residents and environmental groups mobilized and filed complaints against industrial actors.

Port-Jérôme

Port-Jérôme is an industrial complex located on the Seine estuary, in Normandy, France. It is characterized by strong local synergies between the industry, the municipality and the inhabitants. Regarding water, the site is

[26] I will refer to the Rhône-Méditerannée-Corse Water agency as the Rhône-Méditerranée agency in this report.
[27] The National Rhône Company, translated in French as "Compagnie Nationale du Rhône" (CNR) is the operator of the Rhône river. It involves three main missions: generating electricity through the management of 19 hydropower installations along the French section of the river, ensuring navigation, and enabling the use of the Rhône for irrigation.

particular for the presence of an industrial water plant. Locally, the salinization of water provision sources and flood risk are important stakes.

Territorial and Socio-Historical Context

Port-Jérôme was founded in 1933, when two American oil companies (Esso and Mobile) settled on the territory (Lemaistre, 2024). These companies remain major players today. Their activity is connected to various subcontractors, and represent a significant share of local employment. The site lies on a continuum of 1,430 hectares (AMARIS, 2019). It covers 4 cities that belong to the Caux Seine Agglo metropolitan area.

The industrial landscape encompasses the historic petrochemical activity, in petroleum refining, chemicals, petrochemicals, solvents and alcohol (AMARIS, 2019). In the past decades, activities oriented towards circularity or the ecological transitions developed. It is at the core of the green reindustrialization. Alongside two other industrial sites, Port-Jérôme has been incorporated since 2023 to a project for the industrial green transitions of the Seine Axis. It is known as the SOCRATE project (Haropa, 2023)[28].

Port-Jérôme is known as an area with limited conflicts and opposition to industrial activities and projects (Observatoire des Territoires d'Industrie, 2024). It has to be understood under local policy arrangements, but also under the light of the prominence of the industry for local employment and spillovers (6,000 jobs are related to the industry).

Industry and the waterscape

Port-Jérôme was built on reclaimed land in the Seine floodplain. Despite this artificialization, some remaining wetlands are classified as of ecological interest for the key functions they provide (SAFEGE, 2015). Wetlands in Port-Jérôme are currently threatened by reindustrialization policies that involve further artificializations.

Regarding water provision, industries mainly rely on the Seine, its groundwater, and the Commerce River. A key feature of this complex is the Norville industrial water plant. Built in 1969 after aquifers became overexploited and salinized due to refinery expansion (Catoire and Lecornu, 1972), it shifted supply to surface water. Still, salinization risks remain: climate change shifts the estuarian salinity upstream (Berne, 2023), and

[28] The two other associations are from Le Havre (Synerzip) and Rouen (UpSide). SOCRATE means "*Synergie pour une Organisation Collective et raisonnée sur l'axe Seine de la Transition Énergétique*" (Synergy for a Sustainable Collective Organization on the Seine axis of the Energy Transition).

overuse could affect groundwater. An ongoing study (an extractable volume study[29]) was commanded by the local water commission to assess the effects of current uses on groundwaters.

So far, drought episodes did not lead to production suspension. The area is affected by hydrological cycle disruptions linked to climate change (Berne, 2023), but in relatively lesser proportions than other places in Normandie or in France. Flooding is however a major concern due to runoff and Seine overflows (SAFEGE, 2015). Climate change increases this risk (Berne, 2023), and the industries, located in the floodplain, are especially vulnerable.

Regarding quality, the Seine water quality has improved in the past 30 years. Historical pollution and current chronic pollution still affect the Seine and the Commerce Rivers (SAFEGE, 2015; Fisson, 2017, 2023). While drinking water is mostly affected by agriculture, the area faced a case of industrial pollution on a metropolitan water intake point (BRGM, 2020)[30]. It led to a year-long bottled water distribution (Banzet, 2012). The intake point remains out of service in 2025.

Governing industrial water uses

The water governance of industrial uses in Port-Jérôme abides by the traditional French system. Industrial water use is overseen by regional (DREAL Normandie) and departmental (Seine-Maritime) authorities, and falls under the Seine-Normandie water agency. Port-Jérôme is covered by a watershed planification document, the SAGE Commerce (by the name of this river), voted by a local water commission.

The metropolitan area – Caux Seine Agglo – plays a pivotal role both in industrial development and water management. The facilitator of the watershed policy (established in the SAGE Commerce) is hired by the municipality. The agglomeration also intervenes in industrial water management, as it owns the Norville industrial water plant. At the local level, various actors can also be involved in industrial water governance, such as the regional park[31]. Some scientific actors also intervene. The *GIP Seine Aval*[32] offers a scientific mediation on the ecological state of the Seine with economic developers. The Geological and Mining Research

[29] Extractable volume study translates as "Étude Volumes Prélevables" in French.

[30] The industrial site at the origin of the pollution is not directly located in the Port-Jérôme complex. It is close, but relatively isolated, further upstream on the Commerce River. I decided to mention this case of pollution as it refers to a case of industrial water pollution managed by the metropolitan area. Furthermore, the site is now part of the Port-Jérôme local monitoring commission. In that sense, it belongs to the complex.

[31] The regional park in this master's thesis will refer to the Seine Loops Regional Natural Park in Normandy. It translates as "Parc naturel régional des Boucles de la Seine Normande"

[32] *GIP Seine Aval* translates in English as "Public Interest Group for the Downstream Seine"

Institute (BRGM)[33] can also be mobilized punctually, on a case-to-case basis. This scientific public institution was commissioned for the extractable volume study (Idée *et al.* 2020). An important economic actor is present as well, Haropa port[34]. The function of this public institution interacts with industrial water governance in some aspects (economic and land development for reindustrialization, decarbonation, etc.)

At the industrial level, companies engage directly with regulation and internal processes. The Norville industrial water plant is a large water mutualization infrastructure that supplies the industrial complex with Seine water. In the context of the Seine's industrial green transition (the aforementioned SOCRATE projects), a study is conducted on the potential for water saving and industrial water synergies at the industrial complex scale.

In the area of Port-Jérôme, there is a limited development of civil society movements that connect to the environmental impacts of the industry. Three main local associations are noted, and take part in the industrial water governance participatory devices mentioned earlier.

Methodology

This master's thesis relies on a cross-case analysis of two industrial sites, approached through qualitative methods. The data is composed of semi-structured interviews and document analysis.

A cross-case analysis of two industrial complexes

By choosing two industrial complexes, Port-Jérôme and the Chemical Valley, I adopted a territorial approach. I found it was the best way to capture the local dynamics of a multi-scalar subject, while the question of water or industrial uses is often portrayed at the national level. The local level also has the interest of embodying the materialities of this topic that cannot be examined with a national vision. The territory is where the water passes through, where the quantity questions materialize, and where the interconnectivities happen. It is also where the industry is physically imprinted, where the effects of reindustrialization are being felt.

[33] Geological and Mining Research Institute translates in French as *"Bureau de recherches géologiques et minières (BRGM)"*

[34] Haropa Port is a public institution born of the fusion of the three main ports on the seine: Le Havre, Rouen and Paris.

The two cases were picked following an extensive review of the literature on industrial water governance in France[35]. They were found to represent a complementarity in the way industrial water governance could be approached. This is displayed by the following similarities and differences. On the one hand, both sites present similar trends. Port-Jérôme and the Chemical Valley are both large industrial complexes, with an activity historically oriented towards the chemical and petrochemical sector. Both sites have also engaged in the green reindustrialization. They are also similarly connected on large rivers, a theme that will be critical in my analysis. Both sites exhibit similar trends, particularly in the development of policy instruments promoting hydric sufficiency. Local governments and state services have encouraged the multiplication of studies to identify water-saving potential at both the industrial unit and industrial area scales. On the other hand, Port-Jérôme and the Chemical Valley display differences, in terms of size, history, and demographics. Port-Jérôme is a small municipality whose existence is closely tied to its industrial site. The Chemical Valley is directly connected to the Grand Lyon metropolitan area, a larger urban area less reliant on industrial activities. I will demonstrate that they are affected quite differently by climate change. They are nonetheless both affected by drought. These differences raise questions about the territorialization of water policies and how water-related challenges emerge in different local contexts.

I approach the two sites through a cross-case analysis, anchored in interpretivist and pragmatic sociology. The pragmatic approach fits the empirically grounded study I conduct in Port-Jérôme and the Chemical Valley. I avoid identifying with a particular water governance model in my approach or framing (Zwarteveen et al. 2017). These cases allow me to produce context-sensitive results on each case. I claim an interpretivist approach in the sense that I am looking at the meaning, logics and practices, embedded in the actors, but also the policy instruments studies. This master's thesis does not have the ambition of conducting a formal comparison between the two cases. Rather, Port-Jérôme and the Chemical Valley are approached in a relational manner. As those two cases will be analyzed in dialogue, it will allow me to map differences but also identify the patterns common to both cases. It favors the analytical generalizability of my findings. This generalization can be favored by the category of interviewees. The actors I am interviewing reach beyond the industrial complex scale and offer sometimes broader perspectives (i.e., metropolitan, department, regional or river basin levels).

[35] Before choosing these two fieldworks, I had already written a report on industrial water governance in France. It was conducted in the context of a research assistant position in the CERI Sciences Po. Over the course of 4 months, I conducted a comparison between two river basins, Seine-Normandie and Rhône-Méditerranée. The report included an extensive literature review on that topic, at the national scale and for these two river basins.

Data collection and analysis

37 interviews were conducted between late December 2024 and March 2025. 23 of them were carried out in-person during the course of two two-week fieldworks in each area studied. The interviews lasted on average an hour and a half, though a few could be shorter (minimum 1 hour) or longer (up to two hours and a half). The rest were carried out remotely, mainly since new actors and opportunities for interview came up while I was already in the field.

As the approach of this master's thesis is on the territorial aspects of industrial water governance, my focus was on the local actors involved in that process. It encompasses decentralized state services, stakeholders involved in river basin or watershed governance, metropolitan authorities and other local actors, scientific experts, industrial actors and stakeholders from the civil society. Interviewees were recruited through a snowball method. I directly contacted fundamental actors that were pre-identified (i.e., metropolitan areas, water agencies, state services). Based on remote exchanges and interviews, I could identify new relevant topics. This semi-inductive method allowed me to map actors that were described in the field as part of industrial local governance. As several interviewees requested to be two attending, I could discuss in total with 44 different interviewees. In that sample, most of the actors taking part in industrial water governance (mentioned in the case introduction) are included. Table 1 summarizes the typology of actors I could interview in each case-study (grey when this typology was interviewed)[36].

This sample - though large - is not exhaustive. The reasons for not interviewing some typologies are the following: they were non-existing (there is no SAGE in the Chemical Valley); they were neither found in the preliminary research nor mentioned in interviews (e.g., absence of cities in Port-Jérôme); they refused to participate or did not answer. On the side of industrial actors, I only have three of them in the larger sample, despite attempts to reach out. Around 15 persons of which I had obtained personal contact through other interviews were reached out to. I find this limited number is, however, partly compensated by the presence of other economic actors (such as Haropa Port or the National Rhône Company), as well as actors related to industries (industrial associations, industrial representatives, etc.).

Throughout the master's thesis, I might refer with some vagueness to some interview (e.g., "an industrialist", "a state services agent"). This is done willingly to preserve their anonymity.

[36] Annex 2 provides further information on the number of interviewees and their specific functions by case.

		Chemical Valley	Port-Jérôme
Decentralized State Services	DREAL (regional unit, service in charge of industries)		
	DDT (departmental service)		
	ARS (regional health agency)		
Hydric scale governance	Water Agency		
	SAGE facilitator (Local water planification document)		
Local public actors	Metropolitan area (economic development & water management)		
	Municipality		
	Other relevant public local actors (Regional Park)		
Scientific actors	BRGM (French Geological Survey)		
	Other		
Industrial Actors	Industrialists (operators, RSE)		
	Other Economic actors		
	Actors related to the industries (representative, competitive cluster).		
Civil society	Local association (neighborhood protection, environmental protection)		

Table 1. The typology of actors interviewed in each case study. Source: Author (2025)

The interview grid was built around the following theme: their diagnosis of the state of water, their activity with relation to industrial water governance, their collaboration with other actors, their knowledge of the measures implemented to preserve and their influence on them, the effects of reindustrialization policies on water development. The grid was adapted to each actor's typology and function. It was also modified in between interviewees to deepen some themes that came up with other local actors.

Post-interview, the interviewees were systematically coded with the software *MAXQDA*. Even though some large themes of coding were pre-defined to facilitate the handling of the data, the coding mainly followed an inductive technique. Regarding interviews, I resorted to the assistance of artificial intelligence (AI) in two instances. First, it was used at level 4 for the purpose of interview transcription from speech to text (with the software *Whisper*). Second, AI was used to help in the translation of quotes from French to English (level 4).

A document analysis also completed the interviews, before and after this phase. I reviewed national scale documents, and documents related to each local context, some of which were mentioned by interviewees.

This covers newspaper articles, but also studies, reports, planification documents, meeting reports and calls for projects.

Outline

This master's thesis is structured in three parts.

The first chapter will discuss how industrial water governance is primarily framed by the stabilization of uncertainty on water and a shared diagnosis. Data production – through a politico-scientific hybridization – implies a primary framing of stakeholder's engagement in the governance process. I will compare the problematization of industrial water use in Port-Jérôme and the Chemical Valley. I will expand on a key finding for the rest of the analysis: in both cases, large rivers are framed as abundant.

The second chapter will introduce the unfolding of industrial water governance, at the crossroads of industrial regulation and water policy. I will show how industrial water governance is framed in a polycentric system by a multi-level mix of instruments that sustain a neo-corporatist approach. In Port-Jérôme and the Chemical Valley, the limits of these compromises are revealed by cases of drinking water pollution by industrial activity.

The third chapter will dive into the question of change in industrial water governance. I nuance a widespread narrative that industrial water use has been revamped in the aftermath of the 2022 drought. By studying the narrative of "hydric sufficiency" and green transitions tradeoffs, notably at the local level, I find that the change is at most incremental. It aligns with a logic of weak sustainability and reinforces the *status quo* of the growth-oriented paradigm.

Chapter 1. Framing water: how diverging perceptions inform governance

> "The idea [in this institution] is, first and foremost, to avoid arguing over the state of the estuary. Instead, it's about observing, documenting, and referencing. [...] For us, it's going well. Now, there are conflicting interests. We see plenty of examples like this in the estuary because it's a relatively small area with many different and often contradictory issues and uses. Fishermen don't have the same needs or priorities as [the port] *HAROPA*, or as Port-Jérôme in relation to the nearby reserve. And then there are also tensions with the natural park."
>
> - A scientist from the *GIP Seine Aval*.

Governing industrial uses of water is a matter of knowledge production. This scientist from the GIP Seine Aval highlights this critical step. This scientific institution works on data production on the ecological state of the Seine Estuary. It then connects this knowledge with the actors of the economic development of its estuary. "Observing, referencing, documenting". These steps he mentions emphasize the critical role of data production to drive public action on water (Barreteau *et al.* 2020), whether it is to assess industrial compliance with the regulation, to establish the yearly fees by water agencies, or to drive the river basin policy. This first chapter will focus on this fundamental step of industrial water governance: the production of knowledge, to diagnose the status of water and to frame public action.

In a polycentric and dispersed governance landscape, water stands at the intersection of "contradictory issues and uses," with a range of diverging visions and agendas (Méral et al., 2008, p.87). This complexity is compounded by the physical and social uncertainties surrounding water (Molle, 2011). To act upon the resource and conduct public action, a certain stabilization of knowledge about its state is required. Water-related institutions thus rely on a "shared diagnosis"—what the GIP scientist describes as a way to "avoid arguing" over the state of the resource. Yet, this stabilization of knowledge is far from a neutral endeavor. What does one observe? What does one document? Who has access to the data, and who can interpret it? Studying the production of data is therefore fundamental to understanding water governance, as it shapes and frames the possibilities of public action (Woodhouse & Muller, 2017, p. 5; Liziard et al., 2020).

For that endeavor, I shall study the data produced through the lens of policy instruments. This allows to both dissect the instruments resorted to for data production, as well as the representations and problematization of water they involve (Lascoumes and Le Galès, 2007). This also involves resorting to the sociology of science, and science and technology studies, that have extensively tackled the political dimensions of knowledge production (Barbier *et al*. 2010; Gardon et al., 2020)

In this chapter, I will argue that industrial water governance is primarily framed by the stabilization of uncertainty on the resource and by a shared diagnosis. This step already hints at a preliminary framing, whether it is through the taming of uncertainty regarding data production, or the taming of alternative framings on the state of water. I also find first signs of power dynamics in industrial water governance. Comparing the cases of Port-Jérôme and the Chemical Valley, I identify that a permanent character of the framing lies in a so-called abundance of the river. This concept will be fundamental in understanding public action on industrial water use.

The chapter is structured around two axes. The first examines the multi-scalar profusion of data production, and points at its challenges. The second dissects the extent of the shared diagnosis in each case study, mapping various definition struggles. It will allow me to compare framings in Port-Jérôme and the Chemical Valley, and reveal the way larger rivers can be represented in France.

2.1. Stabilizing uncertainty on the resource, a preliminary framing

> "The real issue is the assumption that we already know everything. You have geological maps, rainfall data from *Météo France*, and industrial measurements of water extraction. So, you might think we have all the answers. But in reality? We know almost nothing. [...] There's a whole world of knowledge we're still missing. And that's where it all starts—understanding the underground. Mapping it, conducting subsurface scans. But each small area of study costs hundreds of thousands of euros. And France is a big country. So, every step requires funding, time, and expertise to gather data."

Industrial water governance is based on data production that abounds at all levels of its governance. Yet, the extent of remaining uncertainty is often ignored. This quote from a scientist working for France's public expert bureau for geology and water resources in Normandie (the BRGM) emphasizes it. In the extent of uncertainty lies sidelined problems on water use. Data production unfolds as multi-scalar process, in the grips of scientific and political requirements.

In this section, I will argue that the production of data[37] belongs to a politico-scientific hybridization, that tames the extent of uncertainty and frames the possibilities of public action and stakeholders' engagement in the governance process. I will resort to the lens of policy instrumentation, studying its unfolding and resistance (Lascoumes and Le Galès, 2007, Le Bourhis and Lascoumes, 2014).

This section will proceed in two subsections. After the introduction of the data's omnipresent and multi-scalar characters, the struggles and preliminary framing of water governance will be tackled.

Data production at all scales: the basis of industrial water governance

Industrial water governance requires data production at multiple scales and times, both on a routine and at an *ad hoc* basis. I find that, in a polycentric system, data is produced at multiple scales and involves a diverse range of actors. First, I shall expand here on the four main purposes of data production observed: a routine for industrial water governance (1); a basis for water policy making (2); a prospective for future uses (3); and data as a source of proof (4). I will then discuss the typologies of actors involved.

Data belongs to the industrial water governance routine. On a regular basis, infrastructures are implemented to monitor water abstraction and substance release. It is necessary both for the *DREAL* to check the compliance of industrial activities with the regulation (e.g. abstraction and substance emissions thresholds), and for the water agencies for the calculation of yearly fees. In the case of applications for subsidies to the water agency, a study on water uses and the potential for improvements (in emissions or abstractions) is required for the agency to examine the case file.

Data production is also a basis of water policy-making at different scales. At the hydric scale, key water planification documents – the *SDAGE* and the *SAGE* – are based on a state of the art of the resource, that are conducted every six years for the new policy cycle. Public authorities also need data in times of crisis, to justify and organize political action, such as in the context of a drought decree application (Riaux *et al.,* 2009). Industrial water use can also be shaped through *ad hoc* study productions that serve as a basis to shape day-to-day industrial water use. In the Port-Jérôme area, an "extractable volume study" was demanded by the local water commission. The goal is to assess whether the underground resources are being exploited by end users

[37] define data and knowledge following Baker and Mayernik (2020). Data production consists in the generation and the organization of data for future reuse. It often involves standardizes procedures and metadata. Knowledge is a social endeavor. It entails the analysis and interpretation of data to produce insights, theories or conclusions. I will often refer to the term of study, that I understand as a structured investigation to collect data. It results in knowledge production.

in the in the Commerce watershed, that covers Port-Jérôme industrial complex. If the results of this study prove so, the local water commission could take measures with quantified limits of intakes by end-users. The DREAL Normandie could then prescribe maximum thresholds for water intakes to industrial facilities in Port-Jérôme As a DREAL Normandie agent explains:

> "If we don't have a study on the extractable volumes for each watershed, we'll be stuck. Because that's what will allow us to determine what can actually be withdrawn and what cannot—along with how it should be allocated. [...]. We need to know whether we're depleting the resource or not."

In this excerpt, the expression "being stuck" refers to the impossibility of state services to revise intakes authorizations without data to support it. If revisions are conducted, the maximum thresholds will incorporate the "day-to-day" industrial water use monitoring mentioned above. Parallel to the regulatory realm, data can also be produced to inform decision-makers on the states and pressures on water. As mentioned before, the GIP Seine Aval in the Port-Jérôme area produces studies on the Seine Estuary. The interviewee from that structure explained how this institution pertains to a logic of dialogue with the Seine estuary actors, either public (notably the Water Agency, Caux Seine Agglo, Haropa port) or private (such as industrial federations). The goal is to encourage policy-makers to base their decisions on a clear understanding of the stakes involved in water preservation.

Tied to policy making, the production of data can also have a prospective character informing future action, either public or private. Beyond its assessment of the situation, the extractable volume study in the Port-Jérôme area aims at the production of simulations. A computerized mock-up will model the state of water resources, depending on climate conditions or anthropic activities. In Port-Jérôme and the Chemical Valley, studies were conducted to assess the saving and circularity potential in industrial water uses in the complex. It maps potential for future synergies. In Port-Jérôme, the study also encompasses a larger "trajectory" study. Taking water as a factor among others such as emissions, it aims at having a prospective character, with the analysis of various scenarios for the industrial green transition. In the Chemical Valley case, the Rhône-Méditerannée water agency commissioned a study on the evolution of Rhône water flows (2014). Though not requiring direct action at the moment, it gives orientations and visibility on the future of the river until 2100.

The case of the PFAS in the Chemical Valley emphasizes the production of data for a particular motive, to assess the extent and responsibilities of the pollution. The Grand Lyon metropolitan area engaged in a judicial procedure (that is still ongoing) to demonstrate the culpability of businesses Arkema and Daikin

in the pollution. By order of the judge, an expertise is conducted until 2026. Additionally, the metropolitan area financially supports several studies on PFAS in that same endeavor.[38]

Who are the actors involved in the data production of industrial water governance? I shall first introduce the actors collecting the data, and then expand on the actors that receive it. For routine industrial water governance, the actors of data production are well-summarized by this industrialist from Port-Jérôme:

> "Currently, we are already monitored on a monthly basis through *GIDAF*. We report all our discharge and withdrawal values, the volumes we extract and release, as well as all the monitoring of key parameters. This is done in our laboratory, as we have an analysis lab that allows us to conduct physico-chemical analyses and monitor our processes. We also have a section dedicated to the wastewater treatment plant. We use automatic samplers that take measurements throughout the day. We collect these samples and analyze them for parameters such as COD, TSS, phosphorus, nitrogen[39], etc. [...] Then there are all the consulting firms[40] that can carry out studies for us. We also have analysis laboratories that perform unannounced or on-demand tests of the water."

Several elements can be highlighted here. This industrialist highlights the self-monitoring conducted by industrialists, a topic I shall come back on later in this section. It is a legal obligation of the industrialist[41]. They are, in that sense, responsible for some data production through internal devices certified by the public authorities. The *GIDAF*[42] is a software in which industrial actors inform the result of their self-monitoring online[43]. It allows for the centralization of data and its transmission to state services, that then review it. The interviewee also emphasizes the role of other actors in science production: laboratories and the consulting firms. When commanding studies, I observed that public authorities also resort to consulting firms, alongside

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[38] For instance, the Eco-citizen institute is commissioned with two studies: PERL on human biomonitoring of PFAS pollutants among residents living near industrial facilities, and OPAL focused on chemical industry workers. The Léon Bérard Cancer Center in Lyon studies the connection between PFAS exposure and certain types of cancer. Another program, the MATTISE project studies the levels of contamination in the environment, and the transfer between environmental compartments (soil, water, air).

[39] These parameters include the following element: COD (Chemical Oxygen Demand), which reflects the amount of organic matter; TSS (Total Suspended Solids), which indicates the presence of particles; and nutrient levels like phosphorus and nitrogen, which are linked to pollution and eutrophication.

[40] The expression "consulting firm" was translated from the French *"Bureau d'étude"*

[41] This obligation is indicated in the order of February 2, 1998 relating to water withdrawals and consumption as well as to emissions of all kinds from installations classified for environmental protection subject to authorization.

[42] GIDAF stands for "*Gestion Informatisée des Données d'Autosurveillance Fréquente*". It translates as "Computerized Management of Frequent Self-Monitoring Data."

[43] This is indicated in the Order of April 28, 2014 concerning the transmission of monitoring data on emissions from classified installations for environmental protection

other actors, such as NGOs with environmental engineering competency, or organizations specialized in science production, such as the *GIP Seine Aval* or the Eco-citizen institute. The BRGM, France's public bureau for geology and water resources, occupies a particular role as a state expert. This network of data production actors is at the very basis of industrial water governance.

The data produced are then transmitted to the stakeholders that ordered their production. In the fieldwork I observed it is mainly public entities: the DREAL, the water agency, the local water commission, and the local authorities. Private actors emerge as well, as I introduced with the studies on water saving and synergies potentials in the two industrial complexes. Comparing the existing knowledge on the local water situation in Port-Jérôme and the Chemical Valley, I noticed that the presence of a relevant hydric institution made a difference in data availability. In Port-Jérôme, the SAGE Commerce displayed a state of water, with the quantification of intakes by use on the water bodies, and the different pressures exerted on water bodies. In the Chemical Valley, no local water management tools exist below the river basin level. As a result, it was very difficult to find information on the types and extent of water-related pressures. In Port-Jérôme, it is also thanks to the existence of a local water commission that the extractable volume study could be conducted. It opens the way for public action at a coherent hydric scale, which is not possible in the Chemical Valley area.

Whether it is at the stage of ordering knowledge production or at the appropriation, the production of data and its translation are not neutral endeavors. They reveal puzzles, but also conflicts that I shall expand on below.

The conflicts and the struggles of data production and appropriation

Data and studies, despite their apparent objectivation, are not neutral. They are shaped interactions between the human and the social. Jasanoff expresses it under the concept of "regulatory science": "a hybrid activity that combines elements of scientific evidence and reasoning with large doses of social and political judgement" (1990, p.229). Studying a case of water governance in France, Barbier *et al.* appropriate this concept through the policy instrumentation perspective (2010). They demonstrate how the management of the drought, with its subsequent data production belongs to the same logic. Data production on water blends hydrological science and socio-political components (*ibid*., 18). Anchored in this perspective, I shall analyze these hybridizations observed in my fieldworks. After having discussed their forms in the production of data and in its appropriation, I will turn to the implications it has for the governance of industrial water use.

I find that data is tinged with the political in three main domains in industrial water governance: the definition of thresholds, the self-regulation of industrialists, and the anticipation of appropriation tensions.

As we saw, industrial water governance is framed by the respect of water emissions and abstraction thresholds. It is on their basis that industrialists use water. This calls to questions the way the thresholds are determined? An interviewee of the Eco-Citizen Institute - hired to work on a study on PFAS - points at the limits of "official indicators":

> "Official knowledge is generally framed by regulatory texts. And until now, regulations on PFAS were virtually non-existent, as was the case for ultra-fine particles. Basically, current regulations only cover around fifty parameters [...] So essentially, you're measuring a set of parameters, comparing them to arbitrarily defined thresholds, and stopping there. From a scientific standpoint, that doesn't amount to much—we're just in the realm of norms. Which is already something, of course, because norms usually push thresholds downward. But really, we can't extract much meaning or insight from that data."

At least two elements can be noted here. First: the interviewee states that regulatory thresholds are defined "arbitrarily". I interpret this qualification as referring to a perceived "absence of logic" in determining thresholds. Among other limits, their determination is based on *in vivo* tests on animals, relying on a "dose makes the poison". This principle is criticized for overlooking the long-term effects of low dose and combined exposure[44] to substances (Gardon et al., 2020, 104). Second, the interviewee mentions that PFAS were "virtually non-existent". It highlights how the current regulation, and the threshold systems, leaves outside of its scope a high number of chemical substances. The absence of tracking does not remove the potential harm. This is furthered by the fact that the number of substances entering the market exceeds largely the possibility to follow them all (Grandjean, 2013, 658).

The political dimensions of data production lie in the actors producing it. Experts are taken in a tension, between their necessary proximity with the regulators, but also the requirements of distance for the purpose of neutrality (Robert, 2008). It is well documented that the scientific actors permeate the political boundaries (Jasanoff, 1999; Bouleau and Fernandez, 2012). In the context of industrial water governance, what is notable is the role of industrialists in data production that follows their own compliance. This paradox

[44] Regulatory toxicology relies on the fundamental principle that the severity of chemical effects on an organism is proportional to its exposure level. This claim is challenges, notably by chemicals that interfere with hormone (Zoeller and Vandenberg, 2015).

is exemplified by the following excerpt of an interview with the president of a neighborhood association in the Chemical Valley area. I should contextualize these remarks in the setting of the PFAS pollution revelation:

> "You're saying these [industrial] companies are supposed to self-monitor, with occasional inspections, notably from the DREAL. But I'm saying—we can't just trust that system. They can't be both judge and jury. They're the ones choosing the laboratory that carries out the analyses. I'm not saying the labs are… but still… you see the problem."

While the position of this interviewee on the independence of laboratory[45] is unclear, this quote clearly shows a mistrust in the institutionalized self-monitory system. More broadly, it targets the ability of the state services to engage with this monitoring. It recalls what Le Naour observes on industrial governance (2024): with this self-monitoring system, industrialists are made "owner of the problem" (*ibid*., 7). Through the data produced, they define the risks and the means to prevent them (Vlassopoulo, 2007). This self-monitoring system is far from a detail, or a fact. It is the product of a progressive devolution of data production to industrialists by state services, a theme I shall expand more on in chapter 2.

Finally, the political dimension of this model comes up as the appropriation and acceptation of the results is anticipated. In French water politics, the production and reception of data is shaped by concertation (Vergote and Petit, 2016). Hence, a fundamental issue for public authorities is the result of the study being trusted by end-users, or at least accepted, for the subsequent policies to be implemented (Barbier *et al.,* 2010). Yet, any production of data involves estimation and patchworks that have to be understood by the participants. Conducting the study on extractable volumes, an interviewee from France's public expert bureau(the BRGM) underlined the struggle of data gathering on water, known to be challenging (Le Bourhis, 2003; Barreteau *et al*, 2020): dissemination of information, mismatch between the units required, incoherence between databases of the water agency and the state services. In the production of models, the scientists have to compose with the residual uncertainty and estimates. For these reasons, when the study is commissioned for river basin or watershed policies, authorities try to involve end-users from the onset. This is explained by an agent from the Seine-Maritime decentralized state services:

> "In other regions, where extractable volume studies were launched without involving the stakeholders […] they were immediately challenged. Then comes the next phase: 'Here are our extractable volumes, now let's talk about how we allocate them.' - 'But if I don't even agree with your diagnosis or initial findings. Are your calculations even accurate? […]' In some areas, the studies were completed, they

[45] In France, laboratories that carry out substance testing for industries must be accredited and officially recognized by the public authorities.

> were expensive, but because the findings weren't shared with all users, they couldn't be used to manage water rotation or allocate volumes among users. So now, the work basically has to be redone."

What this agent describes pertains to a logic of resistance to instruments, contesting the reliability of the study (Barbier *et al.*, 2010, p. 19). This is just one example of how the anticipation of appropriation struggles permeate the production of knowledge (*ibid.*). It could also extend towards bypassing or discrediting the results of the study and what they imply (*ibid.*). The political and scientific boundaries are constantly crossed.

What are the implications of this politico-scientific hybridization for industrial water governance, and why is it important? Three main dimensions emerge: it recalls the extent of uncertainty in the decision-making process; data production already involves a preliminary framing of public action; and it has implications in the participation of stakeholders.

Political hybridization highlights the extent of uncertainty on water. The struggles in data production and the residual uncertainties – though they do not necessarily question the validity of the study – shed light on the lack of knowledge on water, and the struggles to grapple with. The acknowledgment of this uncertainty can unveil the limits of public action. In the Chemical Valley, the existing data on industrial uses displays major gaps. On a question on the source from which industrialists withdraw water, an inspector of the DREAL responds :

> "That's really the core issue we're dealing with right now—figuring out exactly where [the industries] are withdrawing water from. Many claim they're taking it from what's called the Rhône *drain*, so the question is whether it's actually groundwater or surface water. I don't think they're drawing directly from the Rhône itself. It's mostly either from the drain or from the accompanying aquifers. But at the moment, we're right in the middle of trying to diagnose and clarify exactly what they're withdrawing and from where."

After this answer, their colleague completed quickly that they have "key figures" on the total intakes. This could signal an attempt to reassure that there are still grips on industrial uses, that data is collected and that it is accessed to some extent. This excerpt underlines nonetheless that uncertainty stands strong. Neither the source of intake (surface or groundwater), nor its extent are precisely mapped. The interviewees further explain that this lack of knowledge is linked to the age of the industrial facility, with old extraction wells, of which the location or the depth is not well known. Their declaration is coherent with other interviews, in which the age of the facility is often a factor pointed at for the limited knowledge on water. Yet, the production of quantified data, despite the uncertainties, create an illusion of knowledge on the resource. Working on a

case of extractable volume studies, Vergote and Petit explain that "figures anchor the reflection in past values taken as references: the figures stabilize the perception of the resource, obscuring the idea that flows and withdrawable volumes could decrease" (2016, p.9). How can one govern a resource without knowing its state and uses? They are the basis for regulation; the source of water abstractions defines the authorizations and fees. This leads us to the second theme.

The acknowledgment of data is important because it frames the scope of public actions. To be deemed worthy of public action, a situation must be perceived as needing or being capable of being different (Padioleau, 1982). To claim a difference, the situation should be known. What about the substance outside of the parameters followed by the regulation? The PFAS are - as mentioned by an elected official from Grand Lyon - just the "tip of the iceberg. There are thousands of other substances of which the effects are not known yet, without counting the unknown effects of interaction among different chemicals in water (Fisson, 2014, p.41). The absence of data renders invisible the construction of a problem. The regulatory instruments mask the existence of substances. Doing so, it impedes to study their effects on humans and the environment (Boudia et Jas, 2007). In that regard, the instrumentation of political action cannot be seen as a full protection, but a navigation through uncertainties and gaps.

Data production also matters because it shapes the interactions and the relationships between and within the governing and the governed. First, the theme of trust - critical in water governance (Bafoil, 2024) – comes up. It is about trust in the quality of the data produced (with a certain extent of uncertainty) but also trust in the producer of data. This is particularly reinforced with the self-monitoring role of industrialists. On that topic, Le Naour points how, since the 1970s onwards, industrialists have gained an "expertise monopoly" as the legislation evolved to favoring economic development at the expense of environmental evaluations (2024). Among the laws she mentions, there is the "Law for a Government Serving a Society of Trust"[46]. Trust comes again. But here, the "society of trust" seems to rather be the trust between the state and industrialists, or the trust that the citizen should have in the pollution management system. An industrialist in Port-Jérôme, regretting the "lack of trust in our society" still notes on their interactions with the inspector:

"With the authorities, I would say we are rather in a relationship of trust."

On the PFAS theme, a representative of industrial actors in the Chemical Valley declares:

[46]"Law for a Government Serving a Society of Trust" was translated from the French law "*loi 2018-727, pour un État au service d'une société de confiance"*

> "So, let's be coherent: there are regulatory constraints [on the PFAS], that the DREAL are monitoring, taking up the issue, regulating, and conducting inspections. Let's trust the authorities and the industrial actors to move forward on this topic in a calm and constructive manner."

This excerpt postulates the trust one should have in environmental management towards the state and the industrialists, while portraying, indirectly, citizens and the media as neither calm nor constructive. "Trust" here is used to delegitimize citizens' claims for more transparency. Again, what is the worth of trust when one notices that industrialists have been emitting pollution for years, while being aware of their toxicity for the environment and people? In this sense comes the second theme: the production of data frames the debate on industrial water governance. Data produced on water use is dominated by quantification: quantity of water taken, water released, quantity of volume to be extracted. The conversation and debates in industrial water governance are framed around technical themes. It tends to exclude non-expert actors, a theme I shall expand on in chapter 2. Yet, quantitative approaches shall not be taken as the only existing option. Farinetti (2017) analyzes the transition from a sensorial approach to justify legal action against an industrialist (e.g., the smell, the color of a river) to a numerical one (i.e., thresholds) from the 18th century onwards. Among other conclusions, she observes that "this increasing technicality in water-related criminal law tends to obscure the symbolic message of protection—and, by extension, the affirmation of essential social values—that it conveys to the public" (*ibid.* , 151). This quantified governance of water uses excludes alternative visions to dominant scientific expertise (Marquet, 2014), that still retain some interest in governing water (Farinetti, 2017).

This analysis displays how data production in the context of industrial water governance involves a preliminary framing on the way water can be governed, through what principles and dynamics. This data, as we saw, is at the basis of the shared diagnosis. How does this hybridization unfold?

2.2. Behind the shared diagnosis: convergence and struggles on water

The production of a shared diagnosis, despite its stabilization, does not erase the multiple representations and agendas around water (Gardin and Rinaudo, 2002; Richard-Ferroudji, 2008; Barreteau et al., 2022). The cohabiting representations of a river, far from innocent, influence present and future political action. In these representations lie keys to understand industrial water governance. This is what this section offers to study: the multiplicity of representations of water that cohabit. What is the extent of the shared diagnosis in each case? What is the framing of the problem for water industrial uses? It convokes the notion of "problem framing": how a given situation is constructed as a social problem deemed worthy of public action through

mobilization and collective action of actors engaged in a struggle of meaning (Gibert and Henry, 2012). I further precise here that the framings I dissect in this sub-section focus on industrial water uses, and not the general water question. The goal is to provide an image of the dominant shared diagnosis in each case on that issue, map the alternative framings, and the potential definition struggles that may arise (Gilbert and Henry, 2012). The vagueness retained by the shared diagnosis in water policies is encapsulated in the statement of an industrial representative in the Chemical Valley:

> "In the end, the common ground is that we all recognize that water-related issues are both today's and tomorrow's challenges. And we know that reaching consensus and agreements will be essential to implementing policies that are coherent and in the best interest of all users. [...] But of course, we don't always agree on everything. Still, disagreement doesn't mean we don't want to move forward and find common solutions."

According to this interview, actors want to move forward for a similar goal, even though they have diverging interests. Yet, the nature of the goal appears unprecise – water as "today's and tomorrow's challenges". To map the divergence of interests, I choose to analyze the framing of the problem for water under a scope that approaches it through its uses and functions. As explained in the introduction, I identify five dimensions: Water as a resource consumed for industrial uses (1); Water as an absorptive capacity, to receive the effluents and dilute them (2); Water as a threat, such as flooding or drought (3); Water as a habitat, an ecosystem in which biodiversity may thrive and wetland ensure their ecological function (4); and Water as a resource to be shared among different users (5).

In this section, the comparison between Port-Jérôme and the Chemical Valley will allow me to argue that – even though the framing of water use is profoundly territorialized – three main representations are developed and support industrial sectoral interests: the underestimation of water as a habitat; the framing of water as abundant; and the naturalization of industrial water uses.

This section will be structured in three distinct parts: the problem framing in the Chemical Valley, the problem framing in Port-Jérôme, and a comparison of both cases.

The framing in Lyon

In Lyon, the framing of the industrial water use problem was – at the time of my fieldwork – dominated by the PFAS theme. Nonetheless, this dominant framing shall not mask two other cohabiting framings: the availability of water from the Rhône, and the role for water as the habitat ecosystem life. I will expand below on the three approaches.

PFAS and the definitional struggles: responsibilities and doubt

The PFAS theme appeared as salient throughout my interviews. The dominant framing is around water as a shared resource. The question revolves around drinking water provision, both through the lens of public health and the costs of pollution. Some of these costs linked to metropolitan water provision cover notably 5 million euros for the interconnection to deliver safe drinking water, and an extra 600,000 euros per year in operating costs for the plant to filter PFAS. This framing does not exclude the environmental impacts of the pollution. The following excerpt from an interview with the Grand Lyon metropolitan services sheds light on different dimensions of the problem framing on PFAS:

> "Conducting these studies [on P-FAS] helps advance knowledge, allowing citizens and the media to make use of it, and it will also contribute to ongoing and future legal proceedings—because there will be more—to make use of all the findings that have been brought to light. It's also a genuine mobilization of scientific partners. The more we advance science, the more visibility the issue gains, and the more we enable citizens to understand and form their own judgment about the situation. So, this is truly a way of taking action. As I said, we are working on two fronts: one is curative, aiming to restore the quality and compliance of information provided to the public; the other is scientific, through this study, which is essential because we are facing one of the most powerful lobbies in France and Europe—the chemical industry—which has, for decades, been engaged in a strategy of manufacturing doubt. They continuously manage to push back against studies, scientific claims, and research by asserting that 'there is no problem, there is no proof.' The burden of proof, in cases of pollution like this, inevitably falls on the victims.

This excerpt draws up the coalitions I could observe in the definition struggle to fight for the imposition of a problem frame over another (Gilbert and Henry, 2012, p.38). On the one hand, the metropolitan area, a share of citizens, and the media are aligned to have the pollution damage recognized. The notion of "citizen" also encompasses here citizen associations, that have had a role in the mobilization. Several judiciary procedures against industrialists responsible for the pollution have been – or are – ongoing, from local associations but also the metropolitan area or cities affected (Notre Affaire à Tous, 2024; Lemerle, 2025). On the other hand, some industrial actors and their representatives, notably the "chemical industry lobby" question the extent of industrial responsibility at the roots of the PFAS pollution, and question as well the effects on human health and the environment as pointed out. Doing so, they undermine or neutralize the opposed interpretive framework. A counter-framing is advocated (Benford, 1987; Benford and Snow, 2000). An example may be found in this interview excerpt with an association representing industrial actors:

> "The issue of PFAS is one that requires careful handling — not just in terms of action, but also in the language we use and the weight our words carry. I'm saying this from a pragmatic standpoint. PFAS is currently an emerging issue. According to the OECD, there are 4,300 perfluoroalkyl or polyfluoroalkyl substances. But if we consider it purely from a chemical perspective — that is, all molecules made of carbon-fluorine bonds — we're talking about hundreds of thousands of compounds. To say today that all of these are toxic or hazardous to human health is a claim that science has not yet substantiated. Toxicology and ecotoxicology studies so far have only covered a limited number of substances. So, we have to be very careful about media hype. I always take a cautious approach, with the aim of avoiding unnecessary alarm over a topic that may not, in fact, warrant it. Today, we're detecting PFAS at the nanogram level — and a nanogram is essentially like a grain of salt in an Olympic-sized swimming pool. That said, yes, there are industries that use or emit PFAS regularly. These are clearly identified by the authorities, and there are active monitoring and research efforts underway. As for other industries whose emissions are unknown, they have been subject to surveillance campaigns regarding their discharges."

The interviewee clearly aims to highlight that the effects of human health – according to them - are not yet proven, and especially points at the limited concentration of the substance in a given volume. There is also an attempt to make the "problem" not existent, or at least circumvent it, emphasizing the action taken by authorities, denouncing the media hype and the "unnecessary alarm". One should not however that at the time at which this was said, the effects had been known for decades. (Horel, 2023). The industrial associations "doubt" the hazardous nature of PFAS, which is qualified as "manufacturing doubt" by the metropolitan representative. Coming back to the excerpt from the interview of the metropolitan services, another arising dimension is the one of scientific evidence. The interviewee from the metropolitan area state that the advance of science advances the "visibility" of the effects of the PFAS pollution. Science is a way to ground the claims, but also to serve as evidence in the judicial procedures, aiming at the establishment of responsibilities. It has a central role in the problem framing, and is also at the core of the definition struggles with this "manufacturing of doubt" (Henry, 2021). Another salient element mentioned by the metropolitan area is the role of the media in this affair, that is also denounced by the industrial representative. It echoes the statement of another interviewee, that was informed by the media of the affair. The metropolitan area, the city of Lyon, and the local associations: all mention the TV documentary *Vert de Rage* that revealed the pollution (October 2022). As the president of a neighborhood association puts :

> "Yes, so it's really thanks to the media that we were informed. It's thanks to the media that we were able to carry out blood sampling, and so on. And it's also thanks to them — you could say not a single

> week goes by without something in the print or broadcast media about PFAS. There are always articles, reports, or features on the subject."

In that sense, the media made the problem visible, broadcasting a "scandal" situation that was unknown from the public opinion (Crespin and Ferron, 2017). Their production also participated in keeping it on the agenda in the public sphere (Cefaï, 1996).

Water as a resource consumed, a non-problem in the Chemical Valley?

As the PFAS question occupies the frontstage, other framings of the water question cohabit, but in more discreet spheres (Gilbert and Henry, 2012), in a less public way. When mentioned, these themes remain contained into internal institutions debates. The notion of water as a resource consumed for industrial uses appears treated in a quite paradoxical manner. On the one hand, almost all the actors interviewed mention the forecasted decrease in the water flows unveiled by a study of the Rhône-Méditerrannée water agency (Agence de l'eau Rhône Méditerranée Corse, 2023). By 2055, it could reach a 20% decrease (*ibid.*). Whatever their typology, the interviewees often express the results of the study as a "surprise". The effects of the 2022 drought are also felt, and an increased attention on the resource is claimed.

> "Industrial actors are very constructive [...] No particular reluctance, really. There's more of a shared belief[47] that the resource needs to be protected. Well, water—since it's inexpensive—isn't necessarily well-tracked in terms of withdrawals, consumption levels, and how it circulates within industries from one workshop to another."

This interviewee from the economic department working on the Chemical Valley highlights a form of consensus from the industrial actors on the necessary preservation of water, rather through a quantitative aspect (the volume withdrawn). The conduct of a study on water-saving potential in the industrial complex aligns in this direction. On the other hand, the Rhône is still perceived as a relatively insensitive habitat, for which the stakes of water provision are emerging. As explains an interviewee from the DREAL:

> "As for the Rhône, even today, there's no concern regarding water quantity — there are no drought zones. However, in the context of climate change, we're starting to pay closer attention."

This interview highlights both the notion that the rivers are perceived as insensitive, but also that awareness is raising progressively on the topic. This limited framing of the quantitative risk could also be attributed to a relativization with neighboring territories that face more pressing struggles than the Rhône, with restrictions

[47] "Belief." here from the French word "*adhésion*."

in possible intakes. This is the case for instance for the *Mont de l'Est Lyonnais*. This relativization also happens with other rivers with less waterflow than the Rhône. Talking about a thermal pollution on the Rhône, an agent from the departmental decentralized state services mentions:

> "It's the Rhône's flow that allows for both dilution and evacuation. If you made the same discharge into a small watercourse, you'd overwhelm it — you'd destroy 3 kilometers of river, and it would be considered a serious pollution incident."

The exclusion of water as a habitat

A last framing on industrial water use – way less vocal than the others – is the one of water as a habitat. Industrial water governance in the Chemical Valley could be questioned with regards to the pressures industrial activity could put on local ecosystems. Almost never mentioned, an employee from an environmental association expanded upon it:

> "In connection with industrial activity, the main issue is really land use. These are areas that take up a lot of space and significantly disrupt ecological continuity. They prevent species from moving freely[in the water]—plus, there are roads on top of that. Altogether, it creates these sorts of no man's lands between, on one side, the Rhône and all its ecological richness, and on the other, adjacent areas like the *Plateau des Grandes Terres* near Feyzin."

The interviewee points to the impacts of industrial activities on biodiversity, and notably the ecosystems living in water bodies. It is notable that the question does not revolve around wetland artificialization. In the Chemical Valley, industrial developments rely on a strategy of land intensification.

The framing in Port-Jérôme

In Port-Jérôme, the framing of industrial water use as a problem revolves around two dominant themes: the salinization of the Seine and the risk of flooding. The risk of wetland artificialization remains in the shadow of problematization. I shall expand successively on these three framings. It is to be noted that in Port-Jérôme - despite the framing of water as a problem deemed worthy of public action - there is little evidence of the aforementioned water stakes in the general press. Yet, looking at the reports from the local monitoring commission since 2007, one may note that the water theme has always been present. It just does not seem publicized in the larger public arena. It is rather handled throughout routine decision-making and choices, through the relationships between the DREAL, the Water Agency and industrial actors, as well as the metropolitan area occasionally.

Salinization, a historical and permanent fear

When asking about the stakes related to industrial water use, the dominant framings of the problem that emerge are on the vulnerability of industrial uses to hydrological modifications. Salinization of the water intakes from the Norville industrial water plant and the changes in water availability are often mentioned. The theme of water salinization is not new. As industries developed on the zone in the 1970s, wells in the ground water multiplied and destabilized the river and groundwater flows and favored the salinization of ground water (Catoire and Lecornu, 1972). The industrial water plant was constructed to relieve pressure on groundwater by diverging it to the Seine. Today, the threat of salinization is doubled by the upstream migration of the salt wedge that could reach Norville. An angle of the problem is based on the forecasted hydrological modifications, with longer droughts linked to climate change. It precludes a quality issue linked to modification in the water regime. An agent who had work on the water saving potential in the industrial complex (the SOCRATE study) summarizes:

> "We're going to face a water quality issue—first, because there will be more salt, and second, because during periods of intense drought, when they occur, we'll have problems with higher concentrations of pollutants, soil leaching due to heavier rainfall, and so on."

This relates both to water as a resource consumed, but also to its absorptive capacity. Despite this worry for salinization, local actors consider the Seine river as relatively less sensitive water-body than others, either in terms of dilution or in terms of intake possibilities. An industrialist describes it as a "fairly strong waterway", A DREAL agent mentions that "[The Seine quantitative question] does not seem like a problem".

Water as a threat: flooding

Water as a threat is a hot-button issue that all the actors interviewed have in mind: the area is exposed to flooding, notably by the Seine river. The realization of this risk is recent. Industrialists and the metropolitan department's perspective converge on the fact that this has been an ongoing question since 2019. Industrialists attribute this increased awareness to the pressures of their facilities' insurance companies.

Wetlands in the shadows of problematization

Outside of this dominant framing focused on the impacts of water on industrial activities, there are limited voices conceiving the industry through its impact on the environment. Salinization and decrease in water quality can be treated alternatively to a threat to industrial activity.

> "And just to make it simple, we add a little layer of climate change, with modifications to habitats—especially at the river mouth, where our large mudflats, which are subject to salinity variations and serve as nurseries for juvenile sea bass, sole, and other marine fish—are becoming increasingly salty. As a result, these areas are becoming less suitable for juveniles, so they're shifting upstream. But upstream, we have Port-Jérôme and those zones, and there are no mudflats there. So, what we're seeing is what's called a *nursery squeeze*—these nursery habitats are shrinking because of both the infrastructure developments that are removing them and the rising marine salinity gradients that are pushing upstream and effectively compressing these habitats."

This depiction brough up by an interviewee from the GIP Seine Aval (a scientific organization) shifts the vision of water stakes : the industry becomes a pressure to biodiversity, that is already evolving through salinization and degraded quality constraints. This excerpt also brings in a noticeable void in the dominant framing. Where is water as a habitat considered? The void feels even deeper as it should pertain to a shared diagnosis. "Restoring aquatic environments and enhancing biodiversity" is inscribed as one of the six local water challenges in the local water planification document, the SAGE (SAFEGE, 2015). When asked about the main stakes around industrial water use, and more generally water preservation, only the scientific actors, the water agency, the port and the economic development services pointed at this local water challenge. And even when they mention it, there are wide differences. On the one hand, scientific actors and the water agency describe compensation as a threat to water preservation. An agent from the Seine-Normandie water agency considers it as a major potential for "usage conflict" on water at the local level:

> "There is quite a few reindustrialization projects planned for the area, which will involve using new land currently dedicated to agriculture, but which also hold significant environmental value, particularly as wetlands."

On the other hand, while economic actors acknowledge the biodiversity issue, the conversation revolves mainly around the struggles to find lands for compensation[48]. Water preservation limits industrial activity, as its preservation impedes development.

These alternative framings reveal various appropriations of the problem (Gilbert and Henry, 2012). In the framings mentioned above, it is no surprise that wetlands are mentioned by scientific actors: the Seine

[48] There is a legal obligation to compensate for land artificialized for industrial development, such as wetlands. As new areas are developed for industry, developers face the challenge of identifying suitable land on which compensation can be carried out. In Port-Jérôme, a competition is arising among economic developers on lands open for compensation. This process also raises questions about the environmental functional equivalence between the artificialized land and the land used for compensation

regional park is in charge of their protection, the GIP Seine Aval produces extensive studies on their quality. Cognitively, the way they appropriate the water question revolves around wetlands. On the other side, the economic actors mentioned are neither trained in ecology nor in the preservation of the environment. The economic development service of the municipality made clear to me that they were not specialists in water, and that they relied on the water department for opinions on industrial development cases. Likewise, the other actors who did not mention wetlands – such as the DREAL inspector services - are not directly working on this topic.

This mode of construction is also connected "in a closely related way, to a practical, specific means of appropriating the problem, either through an act or a plan" (*ibid.*, 38). As the dominant framing of the resource is rather on how water is a threat to industries and not the reverse, it may preclude certain public action. There is no evidence of a particularly organized strategy in that regard at the local level. Yet, it does not mean this framing has no impact on water management. The Seine regional park interviewees notice a certain "relief" from the metropolitan area as the legislation aiming to limit artificialization is crumbling. They highlight here that the removal of limits to land artificialization favors the metropolitan area's action: wetland artificialization for industrial development. This prioritization of economic development over environmental protection is also felt by other actors, such as the GIP Seine Aval scientist;

> "All the resources, the development we're seeing, the decisions being made—they're still mostly geared toward economic and industrial activity, rather than environmental functioning. Sure, we now have laws and frameworks that aim to limit these impacts or at least take them into account. But the overall trajectory isn't really moving toward better environmental outcomes or stronger consideration of those issues."

Comparing the framing of industrial uses in two distinct local contexts

What can be drawn from the introduction of the two distinct framings in Port-Jérôme and in the Chemical Valley? I find that on the one hand; the framing of water appears territorialized. The geographies of water use, the history, and the local governance contexts are defining for the differentiation. On the other hand, I observe that convergences in both cases emerge that favor and support industrial water use by economic actors.

Territorializations? From the physical characters to the local governance context

Comparing the framing of industrial water use in Port-Jérôme and the Chemical Valley highlights the territorial dimension of framing, that depends on the physical local context, but also on the culture and history of the territory (Calvo-Mendieta, 2015). As the effects of climate change on water are uneven on the national territory, it is no surprise that each case displays focus for specificities. Besides the physical characteristics, how does the local governance system impact the framing? At first glance, the appropriation of industrial water governance could be perceived as different. In Port-Jérôme, the stakes surrounding water industrial uses are contained into local instances, with limited incursion of the civil society, and even less of the media. In the Chemical Valley, the PFAS theme makes industrial water management a publicized problem, in which the usual actors of water governance, but also civil society and the media take part.[49] Yet, if one puts aside the PFAS scandal, day-to-day governance of industrial water use is still quite discreet in Lyon. There is no particular media publicization on industrial water abstraction or discharge in the Rhône, other than PFAS. There does not seem to be a public debate on this use, or the future of the Chemical Valley as the glaciers melt and the water flows shrink.

The extent of the shared diagnosis

In both cases, what surfaces is the presence of a shared diagnosis, but to a limited extent. The same problem is not unequivocal, various framings cohabit and sometimes come to clash (Henry, 2007; Gilbert and Henry, 2012). In Port-Jérôme, even though the salinization theme is widely shared as a problem, it can alternatively be conceived as a threat to industrial activity, or as an additional pressure to aquatic biodiversity. In Lyon, the diagnosis of the PFAS is the object of an open conflict. Even though there is no negation on the existence of this substance, actors' coalition come to clash on its extent and effects on human health, as well as on responsibilities. Looking at the interviewees categories, there is also a variation in the appropriation of the problem by typology of actors. While industrialists, economic development services, and the DREAL services tend to focus more on the threat water represents to industrial development, scientific actors and associations emphasize the effects of the industry on water.

[49] The logic of publicization of the PFAS problem will be further developed in Chapter 2. – 2.3.

The large rivers and the abundance paradigm

On both territories, and whatever the typology of actors, the Seine and the Rhône were depicted as "insensitive" rivers. Both pertaining to the largest French rivers, these water bodies are seen as able to accommodate water abstraction and effluents discharged. What lies behind this notion of insensitivity is the construction of a certain abundance in the river. With this abundance, river flows are seen as infinite, as well as their diluting capacity. Yet, this situation is challenged by the pressures exerted on these rivers and the projected effects of climate change (Agence de l'Eau Seine-Normandie, 2023; Agence de l'Eau Rhône Méditerannée, 2023). This notion of river abundance is a trope that could be touched upon by other scholars. Vergote and Petit find that the Saône is perceived as "a reliable resource for coping with weather-related uncertainties" (2016, 5). Bouleau and Fernandez find that the visions and uses were developed on the Rhône in the 1950s onward as if the Rhône's capacity for dilution and cooling was considered unlimited, I also find that these perceptions of rivers as abundant displays similarities with other natural resources. Fossil fuel reserves, also perceived as bountiful (Davidson, 2019). Davidson observes however that this vision is challenged with access difficulties and quality concerns that increase the costs of extraction (*ibid.*, p.2). A similar statement could be made of water uses in the industry, with increasing costs subsequent to water being under pressures for its quantity and quality.

Further than the observation, I look at the sources of this construction of river abundance (and ergo insensitivity). I find that it proceeds by a dual relativization. First, it operates partially. Compared to other water bodies, the Seine is conceives as less sensitives to pressures. Even though the effects of climate change on the inflows are known by actors, the stakes for large rivers appear even less pressing. This is further reinforced since the Chemical Valley and Port-Jérôme are both located on large rivers, which had made most of the industrialists exempt from the measures subsequent to "drought decrees" in times of crisis. They were not asked to reduce or halt consumption during previous drought episodes, compared to other industrial facilities on more vulnerable water bodies. Second, it operates in a timely manner. As mentioned before, the quality of French rivers is considered have improved, and the industrialists have decreased their emissions of the substances followed since the 1990s. Even though the PFAS comes to question the standard assumption that "quantity makes the poison" - it is still far from widespread

One could also wonder whether the absence of a governance structure at the scale of the river tends to favor these false representations of rivers as abundant. While the water agency could take this role, it works at the scale of the whole river basin, and has no specific work on the sole river area. This absence of governance

might be considered to further dilute the responsibility of end-users of the river, as no general instance looks at its effects at this hydric scale (Liboiron, 2021).

Legitimizing industrial water uses through their naturalization ?

Alongside a deemed abundance, I observe a tendency to naturalize industrial use of water, notably among industrialists and especially their representatives. Industrial use is seen more as a "nature cycle" in the use of water, rather than an intervention changing the nature of the water cycle (even though these effects are proven, as discussed in the introduction). In addition, industrialists and their representatives often recall the limited share of the resource consumed, especially compared to agricultural end-users. This interview excerpt with an employee of the Auvergne-Rhône-Alpes Chamber of Commerce and Industry is an example:

> "4% of water is consumed at the national level by industries, which is relatively low compared to other uses."

Interviewees from this category often repeated this number to me. This information is used as a justification to emphasize the limited role of industrialists in pressures on water. This nationwide figure omits however that pressures exerted can be stronger when looking at the local level, in industrialized areas such as Port-Jérôme and the Chemical Valley (Arambourou *et al.,* 2023). Among these actors, another trope is that industries mainly use water for cooling purposes, and thus consume little water in absolute numbers. A representative of the chemical industry in Auvergne-Rhône-Alpes states:

> "Something else that should be noted—at least this is the case for the chemical industry, I'm not sure about other professional sectors—is that most of the water withdrawn by chemical industrial facilities is actually discharged back into the environment. That's because most of the water withdrawn is used for cooling the installations. Water withdrawn as a raw material and integrated into the products does exist for certain types of production, but those volumes are significantly smaller than what is used for cooling purposes."

Even though such claims are valid, it can also be attributed to a narrative that minimizes the industries effects of the resource. This is the case even though the impact of water withdrawal participates in the resource pressures. This rupture of the natural cycle, moreover, has effects on the water cycle (BRLi, 2014). To these naturalizations narratives is also added the historical presence of industrialists on the territory, and their role in local employment and growth production. This set up calls not to question, or at least tame the reconsideration of their legitimacy in using water. Industrial use is constructed as evidence. Eventually, this strategy seems to call not to question the functioning of industry when it comes to water uses. A narrative

designating the nuclear industry as obvious was constructed post-WW2 (Hecht, 2004). Could a similar narrative around the industry and reindustrialization as obvious be constructed as well? This is a question the third chapter shall answer, but of which the framings lay the basis.

Conclusion of the chapter

This first chapter has demonstrated that industrial water governance at its basis is tinged with political concerns and involves a preliminary framing of the problem. In that context, the notion of abundance appeared as critical. Whether through the production of data or of a shared diagnosis, the polycentric interests and the uncertainties come to mingle. First, regarding data production, I have introduced how, in a context of actor's profusion at all levels, data serves multiple purposes. It guides policy-making, but is also at the basis of routine water management for industrialists. The latter are the main producers of data in a logic of self-regulation. Doing so, they are given power by design in the governance, which may trigger in conflictual situations (such as the PFAS pollution). Regulatory science, the lens through which industrial water uses are legally framed, also proves its own limits. In the face of the material complexity and uncertainties of water, as well as the impossibility to follow the fast-paced arrival of substances in production, the definitions of thresholds is criticized for its normative and extremely partial character. Data production in that sense already involves a preliminary framing of public action. It partially puts aside the extent of uncertainty and engages actions the crossroads of data and politics. The consultative character of water politics comes to reinforce this struggle, as policy makers anticipate the tensions for the appropriation of diagnosis at the basis of river basin and watershed politics. It calls to the second point: as the shared diagnosis is put forwards, it comes to further erase the uncertainties and the alternative perspective. The study of Port-Jérôme and the Chemical Valley have emphasized the territorial dimension of the diagnosis, with different hydrological and social contexts. Despite their differences, the comparison also displays consequent commonalities in the framing of industrial uses' connection to rivers. Industrial uses come to be legitimized, through the erasing of their impact on wetlands and the construction of this activity as belonging to the natural cycle of water. Most importantly, their action is reinforced by the conception of large rivers – the Rhône and the Seine – as abundant. All categories of stakeholders relativize their vulnerabilities. This notion of abundance, far from innocent, will prove critical to understand the current management of industrial water uses and the projected green transitions pathways.

Chapter 2. Instrumenting water management: solidarity, negotiations and power struggles

> "I'm not saying that the 1950s, 1960s, up to the 1980s were great. I think there has been chronic pollution because there was industrial pollution—not accidental, but chronic. But now, industrial activity is extremely regulated. If you're a Seveso facility along the Seine axis, you undergo 12 inspections per year, covering a wide range of topics, including your discharges into the Seine, your discharges into the natural environment, your emissions into the air, the condition of the soil, and so on. So, the goal of being more resource-efficient is a good one, and it must continue, but it's already underway."
>
> — An industrial representative, Seine Estuary

This second chapter will investigate the modes of governance of industrial water use. On that matter, the words of this interviewee echo the perspective of a number of others I met. The dominant narrative among industrialists, as well as some regulators, is the following: even though industrial activity still pollutes, the sector has conducted tremendous action. The sector is now heavily regulated, to some extent "safe". The claims can be verified through other sources. It is assessed that industrial pressure on water has decreased, in terms of quantity and quality since the 1990s (Fisson, 2017; Arambourou *et al*, 2024). Factoring for that are the regulations, but also the deindustrialization that reduced the pressures on water bodies (Arambourou et al, 2024, p.11). It is also valid to state that the sector is ruled by a profusion of regulatory norms (Bonnaud, 2011, p.38). The various functions and meanings of water studied in the previous chapter, entailing a profusion of stakeholders, favor such regulatory profusion. What does this profusion of regulations say of the governance of industrial uses?

Risk and disaster studies have explored this theme of industrial governance and risk management. A part of the focus was the relationship between the DREAL, the industrialists and the civil society. Water governance studies have also tackled the question of industrial water governance, but rarely as a main focus. In this chapter, I shall contribute to the literature on both of those fields by studying them jointly. Doing so, I showcase and embrace the polycentric character of industrial water governance (Baldwin *et al*., 2018). The layering of both industrial and water governance systems further complexifies the polycentric character of this

governance. The multiple decisions center multiply; they divide and sometimes share responsibilities. Each domain comes to reinforce one another. The scales also come to match and clash. Hydric boundaries (the river basin, the watershed) are layered with administrative ones (regional, departmental, and metropolitan). Logics of terriorializations are observed, with bottom top-pressures (i.e., important local projects that put pressures on the state services) and top-bottom dynamics (applying politics at the local level, adapting the goals to the local stocks, etc.) (Barone and Mayaux, 2019). In this system, actors have an uneven power to influence the goals and outcomes (Morrison et al, 2019).

This chapter has a threefold objective. The first is to introduce the way industrial water governance is conducted, at the crossroads of industrial governance and water governance, across multiple scales. The second is to grasp the continuities between industrial governance and water governance. The third is to map the particular interconnectivities or stakes that water may create on the local level.

Given that perceived regulatory profusion, I find that resorting to the lens of policy instruments is the most appropriate way to tackle it. The goal I pursue is not to exhaustively mention all the instruments, or to analyze each one of them in-depth. Instead, I will be interested in the typology of instruments chosen and dissecting what they entail in terms of problematizing industrial uses and power relationship among stakeholders.

In this chapter, I nuance the view that more instruments equal more safety. I argue that industrial water governance, just like industrial governance, is ruled by a continuous neo-corporatist perspective[50], endorsed by public authorities at all scales of governance. Power relationships are materialized and reinforced in favor of industrialists and their representatives. Tradeoffs tend to favor economic development over environmental goals. In the context of water governance, this system is both reproduced and challenged by the notion of solidarity and distributive justice. Water governance calls for a certain responsibility of industrial uses in their water use (abstraction and effluents). I find that the effects of this neo-corporatist perspective are made particularly evident by a perspective on water, through its hydro-social interconnectivities.

[50] I define neo-corporatist as a system in which the state incorporates organized interest groups (in this case, the industrial sector) into policy-making processes through structured negotiation and cooperation. It does not necessarily imply connivance between the state and industrial actors. Rather, their cooperation is often structured by shared or negotiated sectoral objectives, such as economic competitiveness, employment, or environmental targets. These alignments can produce forms of institutional interdependence without implying full consensus or the absence of conflict.

This chapter is structured around three sections. In the first, I will first analyze the instrumentation of public authorities to frame industrial uses. I find that economic development is a key in the concern of regulators. Second, I shall study the tensions in participatory processes, and especially how the industrial sector retains power in these instances. Third, I will defend that the case of drinking water pollution, because of the materialization and interconnectivities that water creates, exhibits the neo-corporatist dynamics at play in this system, and the overwhelming power given to industrialists.

2.1. Regulating industrial uses: balancing and negotiating conflicting goals

This section dives into the modes of regulation of industrial water uses. The industrial sector retains and is given power by public authorities, both in the design and implementation of instruments. This is reinforced for water governance, and the research of solidarity and equity in the burden of water policies. In this section, I will first dissect how the choice of instruments by regulators is driven by the protection of economic development, while limiting harm on the resource, in a multi-scalar logic. Second, I will discuss the turn towards self-governance, and its limits. Third, I shall look at the implementation of instruments and resistances.

Dissecting the choice of instruments

What kind of instruments rules industrial water governance? I shall dive here into the regulations of industrial uses by public authorities, understood as the DREAL services, the water agency and local metropolitan authorities. Instead of studying the policy instruments separately, I choose to present them jointly, emphasizing trends and continuities in the way public authorities approach the industrial sector. To identify the nature of instruments used, I draw on Lascoumes and Le Galès' typology (2007), which associates instrument types with specific forms of political legitimacy[51]. The instruments perspective I adopt reveals more than relationship between the governing and the governed (ibid.). Industrial water governance bridges as well the relationships within the governing, the Water Agency and the DREAL.

[51] For the purpose of my argumentation, I took two liberties on the model of Lascoumes and Le Galès. First, I added to their approach local governments. They are part of the regulators of industrialists, and are a central locus in my demonstration. Second, I removed a category of instruments *de jure and de facto* standards, as I found no major evidence in the interviews of public authorities relying on them.

The stake at all scales: limiting harm while ensuring economic development

Let us first begin by the dissection of regulatory instruments in the water and industrial realms. How are the governing (public authorities) relating to the governed (industrialists)? What is the nature of instruments used? What representations or problematization do they involve? I shall analyze here how the logics of economic and environmental balance are at play among different types of instruments (regulatory, economic, incentive-based or communication-focused), and across different scales of governance (the national and regional scale with the DREAL, the hydric scale with the water agency, and the local scale, comprising both the metropolitan governments and the watershed).

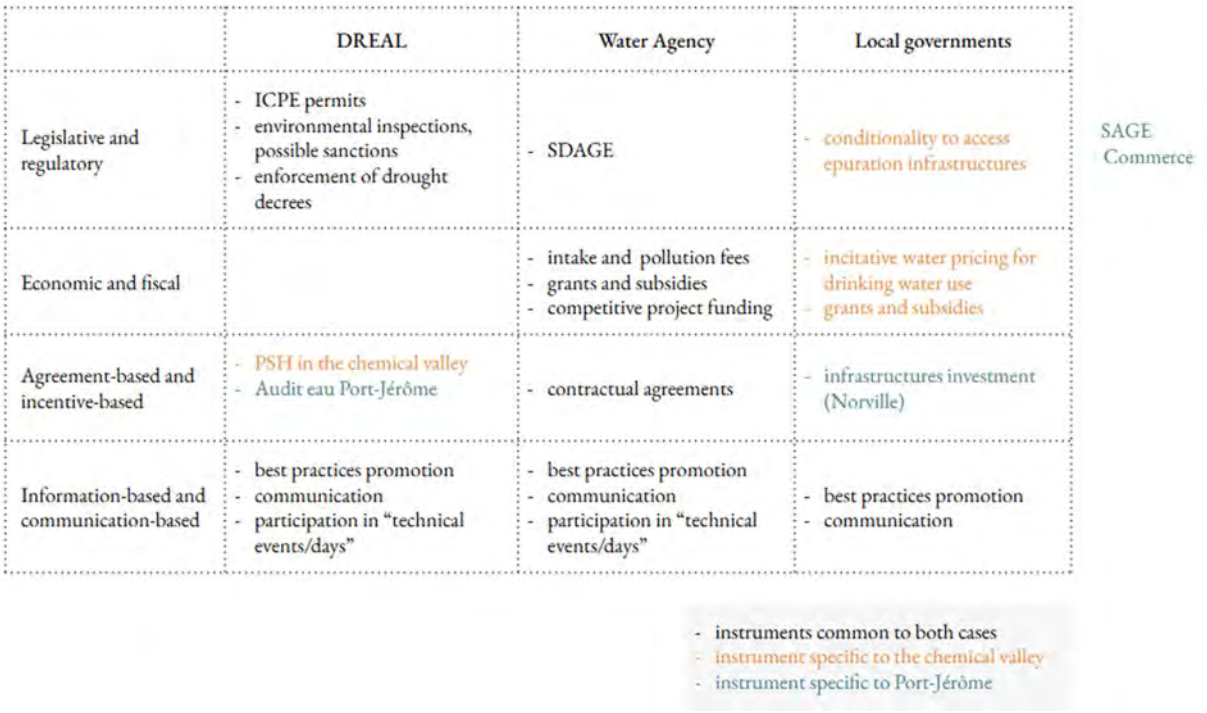

Figure 1. Typology of instruments resorted to by public authorities for industrial water governance. Source: author

First, let's look at legislative and regulatory instruments. One may assume, at first glance, that these ones are solely coercive through the implementation of regulations. But the *DREAL*, that clearly stands out as the main regulatory power, is largely taken up by these compromises. This decentralized state actor retains a symbolic role and a monopoly over the regulation of industrial uses (Lascoumes and Le Galès, 2007, p. 12). Its authority lies in its ability to sanction non-compliance with regulations or put in place temporary measures such as drought decrees. Yet, the regulation also points to an axiological meaning (*ibid.*), mapping out contradictory objectives. This excerpt from an interview with the Rhône state services illustrates the paradoxical injunctions faced by state services: supporting reindustrialization while ensuring water protection.

> "We're kind of walking a tightrope, because on the one hand, we have to take care of the water resource. And on the other hand, we're trying to revitalize industrial activity. [...] It is a bit paradoxical."

These tensions shall be understood within a multi-scalar perspective. Reindustrialization and the preservation of water are both state-led imperatives, pushed through a discussive apparatus (such as the Water Plan, or the series of industrial programs)[52]. There is in this sense a top-bottom pressure, from the central ministries to the prefect and then onto their decentralized state services. A bottom-top pressure can also be observed. The interviewee later in the interviewee how they were pressured to construct and examine the file of an "an important local industrial project" . Such tensions are far from being an exception. As risk and disaster studies widely demonstrate, such tradeoffs between economic and environmental goals are incorporated in the regulatory frameworks. A good example is the historical authorization system governing industrial pollution. Fressoz (2011) highlights that until the 19th century, pollution was addressed in the criminal sphere: workshops could be shut down if neighbors complained. The decree of October 15, 1810, shifted this into the administrative realm, introducing a classification and authorization logic. Fressoz attributes this neo-corporatist shift to the will to protect the capitalist state, that is, the industrialists, by ensuring the continuities of industrial development without the impediments that the criminal handling bore. This legacy still dominates French pollution regulation today: industries are classified depending on the level of risk they represent, and are authorized to release substances in the environment within a certain limit. There is no formal ban on pollution, which would impede industrial development. Instead, exceeding set thresholds is sanctioned. As we saw in chapter 1, these limit values are fixed according to normative principles, with a data production partly transferred to industrialists. The introduction of thresholds pertains to an institutionalized logic that controls environmental toxic substances through the management of the risk, rather than its eradication (Jas, 2010). Furthermore, the environmental code allows some excess in framed contexts[53]. The industrialists interviewed all acknowledge having occasionally exceeded these pollution thresholds, which is understood as a normal and manageable aspect of industrial operations. In this sense, the regulation implemented by the *DREAL* pertains to a logic of "regulations on illegalisms" by state actors (Aguilera, 2019). The regulation of these illegalisms also reveals the impossibility for a state to fully control industrial activity (Sanseverino-Godfrin, 2015, p.4; Serva and Panot, 2021, p.72). In France, there are in total 500,000 facilities

[52] This discursive apparatus will be explored in chapter 3.

[53] See the order of February 2, 1998 concerning water withdrawals and consumption, as well as emissions of all kinds from installations classified for environmental protection subject to authorization. Chapter 5, Section 1, Article 21

with different levels of risks (80% of which are industrial) that can be the object of DREAL control, for 1,600 inspectors (AIDA, 2018).

On the water regulation side, industries also fall under hydric-administrative boundaries with the SDAGE for the river basin level, and the SAGE at the watershed level. The tradeoffs are also at play in these realms, though in less direct ways. The interviewee from Seine-Normandie and Rhône-Méditerrannée water agencies mentioned so far that the agencies enacted not to support financially projects of new industrial development. As new industrial facilities, they are considered as "extra pressures" on the resource. Nonetheless, the agents interviewed mention that it is possible in the future that pressures could come from the ministries, to favor reindustrialization. In Port-Jérôme, the local water commission is consulted on the development of new industrial projects with regards to their impact on the resource. No measures do however directly constrain industrial uses in the watershed planification document, the SAGE. This is the case even though it signals caution for future industrial implementation, as they might increase quantitative pressures on water(SAFEGE, 2015, p.74). Instead of constraints, what is implemented for industrialists seems to favor an incentive-based policy or an economic sponsor: the construction of a pipe to divert industrial effluents from the Commerce River (*ibid*., 172), or the rehabilitation of the industrial water plant to favor water abstraction in the Seine (*ibid*., 181). Nevertheless, alternative interpretations of industrial pollutions and intake could have been undergone. The SAGE could impose to decrease industrial effluents, or decrease water intakes. How should the weakly binding character of the SAGE be understood? On the one hand, the lack of data on industrial intakes or the effects of pollutions might hamper the prescription of decisive measures. This gap is being partly filled by the extractable volume study conducted. On the other hand, as it guides future planification planning decisions, the SAGE might retain some flexibility to not impede any further industrial development. Just like for the state actors, the local water commission seeks a certain balance between economic and environmental development. In the SAGE territory, 30% of jobs are connected to the industry (*ibid*., 66).

Local governments do not escape these tradeoffs logics either. The analysis of instruments used by the Caux Seine Agglo and Grand Lyon reveals however two distinct approaches in relating to the industries. Port-Jérôme's actions rely more on incentives, such as the incentive of financing the Norville Water Plant. The SAGE - of which the facilitator is hired by the metropolitan area – belongs to similar logics. In the Chemical Valley, there is a wider mix of instruments, that could be considered as more binding. The metropolitan water department refuses certain industrial discharges and enforces an increased pricing for industrial drinking water withdrawals. The metropolitan economic department complements this with calls

for projects that frame industrial water use through circular economy logics. The pressures to instrument implementation reveal the distinct metropolitan-industry relationships that I will discuss below

Another share of instruments belongs to the economic and fiscal realm. I shall focus on the water agencies here, since they are systematically mentioned by economic actors and public authorities as the main providers for subsidies to industrial water use. The French water governance system relies on two principles: "*l'eau paye l'eau"*, and " le *pollueur/préleveur-payeur*" (Eau France, n.d.).[54] The connected fees are collected and redistributed by the water agency, via subsidies or calls for projects led by the water agency. Two main criticisms are directed towards that fiscal system and reveal the way industrial water governance is treated: the failure in being a deterrent to pollution and the unfairness of the fee distribution. First, it is criticized for its inexact assessment of the costs of water, failing to apply this "*pollueur/préleveur-payeur*" principle. In that context, freshwater has been a relatively cheap resource to consume and to pollute for industrial uses. [55] An industrialist in Lyon explains:

> "We don't evaluate [the cost of water] very well, we don't track it very well, because, in fact, it's a cost that has been, until now, rather marginal, unfortunately, so to speak. I say 'unfortunately' because it also means that, sometimes, when industrial facilities presented projects to reduce their water intake, in fact, there was no return time on investment. Because when we looked at the water savings made with the associated costs, it would take 25 years to recover the investment."

According to this interviewee, the limited costs of water induced by the system explain both the limiting tracking or care for the resource until now, as well as limited investments for its preservation (BPI France, 2025). Doing so, these limited costs hamper the deterrent character of these economic signals. The roots of this notion – that environmental damage can be priced and compensated – may be found in the 1810 decree (Fressoz, 2011, p.21). However, it is also to be complemented by an environmental governance perspective and history of water governance in France. The tensions between the budgetary logic and the incentive logic are a trope in environmental policy and constitutes a primary resistance, twisting of the economic instrument (Le Bourhis and Lascoumes, 2014). Water fees are intended as deterrents to change behavior, but they are never set high enough to achieve that goal. Water agencies and ministries still treat them primarily as revenue

[54] The "water pays water" ("*l'eau paye l'eau*") means that the collection of fees by the water agency shall cover the investment they conduct. The "*pollueur/préleveur-payeur"* covers both the notion that the actors that release substance in the water (*pollueur*), or that is at the origine of water abstraction (*préleveur)* should contribute financially through the fee system

[55] I shall come back in chapter 3 on the evolutions of the costs of water pollution and abstraction

sources to be preserved, leading them to favor what they see as the acceptable level of taxation (*ibid*., p.503). In the French system, the acceptability of the fees was prioritized (Petit, 2020). A civil servant - working on the founding 1964 French Water Law – explained that the pressures from industrialists on the law ruled out from the debate any fee that could cover the marginal pollution exerted by industrialists (*ibid*.). It makes evident that economic acceptability has been prioritized over strong deterrents, thus undermining the polluter-pays logic. The uncompensated environmental damage by water agencies' fees is set at 5 billion euros per year (Salvetti, 2024, p.35). The industrialist's externalities are not offset by the compensation measures (*ibid*.). That leads to the second criticism: the unfairness of this fiscal system. The externalities of industrial activities on the environment are largely borne by public powers - through the financing of depollution, or the health costs that represent pollution – and by extent by the taxpayers. Yet, these costs appear more diluted within the larger taxation and redistribution system. In water policies, the financing system of fees and allocations at the river basin scale exemplifies and quantifies the unfairness of this distribution. The principle of financial and hydrographic solidarity makes it acute (Carré and Markovitch, 2024). In the river basin committee, the economic representatives are in a position to vote the fees and subsidies they will benefit from (Mayaux and Barone, 2019, p.58). The Seine-Normandie and the Rhône-Méditerranée water agencies have river basins characterized by industrial characteristics, which favor spendings in that sector (Salvetti, 2024, 48). The industry sector is the recipient of 23% of financial subsides in both cases, while it contributes respectively to 5% and 12% of the general taxation. Despite nuances in this imbalance - notably with respect to the agricultural sector's limited contribution - the solidarity principles of water policies remain threaten (Barraqué, 2003 ; Barone and Mayaux, 2019, p.59),

The two last kinds of instruments to be mentioned are the incentives and the information tools. All public actors, regardless of coercive power, also use incentives and agreements. For water agencies, these tools make up for their lack of binding authority. For metropolitan areas, it also aligns with the local economic synergies industrialists represent in terms of local wealth and employment. On the DREAL's side, two territorial tools develop at the regional scale reflect a more hybrid approach: the PSH in Auvergne-Rhône-Alpes and the *audit eau* in Normandie. They were initially applied in territories under hydric stress. The DREAL of both regions have extended their prescription to industrial facilities with high water consumption. These tools require industrialists to evaluate their water consumption and propose reductions. If the objectives are met, exemptions from restrictions measures may applied in a context of drought . The Auvergne-Rhône-Alpes and Normandie DREAL describe these tools as a way to "call industrialists to think" and "reflect on their

consumption". This mirrors trends in neo-corporatist governance once more, with a state positioned as noninterventionist, with a mobilizing role (Lascoumes and Le Galès, 2007, p.13).

The last instrument are information and communication based. They are used across all categories of actors. State services and water agencies try to inform and involve industrialists in the implementation of water policies. Municipalities communicate on good practices, and also relay information. The information and communication area also unveils the role of local actors in the connection between regulators and industrialists. In Port-Jérôme, the industrial association INCASE plays a critical role in that regard. In the Chemical Valley, industrial associations and federations expand on their role to convey regulatory information and provide technical expertise.

The instruments across scales and actors: territorialization and coordination mechanisms

The analysis of the instruments to rule water governance highlight the high number of actors that exist across scales in this polycentric system. How are they coordinated in this polycentric system ? I will analyze the interaction of the DREAL and the water agencies, as well as the sidelining of metropolitan authorities.

Across these scales, territorialization logics rule these systems. The decentralized state services are at the forefront of European and national policies implementations. The water agencies decline the European Water Framework Directive. The DREAL services for their part decline and follow up the application of different European directives (e.g., European Emissions Directive; Seveso III Directive), and national regulations (the series of regulations on industries in the Environmental Code). The DREAL also have a margin in territorializing the applications of regulations, depending on the contexts. Local adaptation of tools—territorialization—is encouraged by law. Regional decrees can be stricter than national ones. A *DREAL* agent from the Chemical valley region expands:

> "The Rhône-Alpes regional drought framework decree is indeed more restrictive. For example, the ministerial decree requires a 5% reduction in water use during a drought alert, while the local decree sets it at 25%. In a reinforced alert, it's 10% nationally versus 50% locally. [...] The most restrictive measure applies."

National frameworks coexist with regionally adapted tools. Clarifying the articulation between local and national instruments remains a challenge (Couvreur *et al.*, 2023)

The frameworks also reinforce one another: the DREAL services more largely (and not necessarily the ones in charge of industries) participates in the river basin policy. The achievement of water "good status" for the European Level, followed by the water agency, can be favored by the DREAL application of regulations on industries. The water agency and the DREAL share goals, with different instruments at their disposal. The DREAL relies heavily on regulation but uses incentives and communication too. Water agencies, with limited coercive power, focus on economic and fiscal tools. In the field, I observe coordination mechanisms among this governing category. The DREAL and the water agencies exercise caution in distributing burdens fairly on industrial users, through an institutionalized system. As an agent of the Normandie Water Agency puts it:

> "We have planning tools that are also shared with State services, notably the DREAL, which acts under the classified installations regulations. In fact, we share priorities—so they use the regulatory lever, and we use the incentive lever of financial aid to act in the same direction."

This illustrates joint planning between state services and water agencies. A guiding document equips such decisions, that are discussed within dedicated state instances[56]. The DREAL and the water agency both pertain to different ministries (Ministry of Industry and Ministry of Environment), that might have tensions (Barone, 2025). Yet, the agent puts it as "shared priorities". This polycentric system also proves hardly readable, sometimes for state services working between national and territorial regulations, but also for industrialists. This limited readability, creating misunderstandings and complexities, could already threaten an instrument's implementation (Le Bourhis and Lascoumes, 2014),

In spite of this decentralization of functions towards decentralized state services and the water agency shall not, one should not be understand it as a retreat of the state from the water governance or industrial affairs. Instead, it rather belongs to a reconfiguration process, whereby its role is reinforced. In that system, the state is to ensure the coordination of these stakeholders and policies at all scales (Ghiotti, 2007). In that regard, I find that municipal authorities seem rather excluded from communication with the state services. No channel of communication is observed between local authorities and state services. The state maintains a consequential role in industrial water governance, leaving room for territorial services abiding by its ministries, but none for the metropolitan areas.

[56] The institutions in which state actors meet are the Inter-Services Water and Nature Mission (MISEN) and the Inter-Services Delegation for Water and Nature (DISEN). The departmental priority actions to be undertaken to restore the water "good status" (in the 2000 Water Framework Directive sense) are enacted in the territorialized Operational Action Plan (PAOT) constructed during the MISEN.

The study of instruments shows how industrial water governance is based on compromises at the expense of water preservation. The public authorities show sensitivity to economic development when put in balance with water preservation. Beyond sensitivity, industrialists are given more power in the governance system, through a dynamic towards self-regulation.

Self-governance tools: complementarity or resistance to public sector's regulation

In the field, industrialists and their representatives mentioned several times how "we should let the industry do its own diagnosis on water consumption", and that "they know better" than the public power. This narrative supports the self-regulation of industrialists. Through that process, the relationship with the state is reconfigured (Borraz, 2007).

France's state policy has already tended, in the past thirty years, to transfer increasing power to industrialists through a series of simplification measures (Le Roux, 2021). It involved notably an increased production of data through the self-monitoring procedures for industrial uses (Boullet, 2012; Lo *et al.,* 2020; Le Naour, 2024). In this context, they build a trust relationship with the state services (Bonnaud, 2011). As one industrialist in Port-Jérôme put it, for a case of momentary effluent exceeding threshold:

> "As long as we're honest, that we present the figures and don't hide anything from them [...] we alert them [...] then trust is built, and things go smoothly."

Honesty refers here to a form of transparency. By things going smoothly, the interviewee could mean that they have a good relationship with their DREAL inspector, but also that they are not sanctioned. This notion of building trust rather than imposing sanctions is inscribed and legitimized in regulatory texts framing the DREAL inspectors' activity (Bonnaud, 2011, p.39). Sanctions are even perceived as a failure for the inspectors (*ibid*.). This notion of partnership and the reliance on participatory mechanisms lead to a form of self-governance. Even in the (rare) cases when they are transferred to the judiciary realm, the sanctions are seldom and the amount of the fee is limited, as the magistrates lack training in this domain. (Serva and Panot, 2021, p.74; Le Roux, 2021; Cour des Comptes, 2023, p.55).

Self-governance also involves the enactment of voluntary codes of conduct. During interviews, industrialists and their representatives often mention internal goals and environmental certification. In 2017, the

International Organization for Standardization listed 1,200 norms related to water (Couvreur *et al.,* 2023, p.118)[57]. Similarly, regulatory authorities - whether the water agency, the DREAL, or local authorities - often mentioned that the industry was a sector relatively "less bad" than agriculture, owing to the "continuous improvement" at the core of their practices, through certifications. In that sense, the logics and merits of self-governance are accepted by public authorities. According to this vision, businesses would be more aware of "feasible" and "cost-effective" solutions (Maurer et.al, 2013).

What does it mean? I analyze these self-governance dynamics as a further devolution of power to industrialists, furthering the choice of instruments that themselves favor economic development over water preservation. Literature has expanded well on its limited effects, and on the motivating factors (i.e. corporate image and social responsibility). Under the name of transparency, scholars demonstrated the methodological and ethical limits of these procedures (Noel *et al.*, 2017; Vigneau et Adams, 2023). Vigneau *et* Adams underline that the failure of transparency to translate sustainability efforts reinforced imbalances with the stakeholders interested with the corporation's sustainability performance: "although transparency was meant to empower end users, it can be used by firms as a symbolic exercise to deflect our attention from their actual sustainability performance, thus effectively becoming a commodity within the global governance markets. [..] [it enables] to maintain legitimacy without engaging in moral development" (2023, p.868).

Policy instrumentation, from the conception, leaves considerable power to industrialists in industrial water governance. Opposing this dynamic, counterweights develop at the local level.

Countering the neo-corporatist pressures ? The local actors at play

As the regulations seem to favor economic development, counterweights also emerge. I expose here the role of the civil society as a counterweight to this hegemonic paradigm, and the potential levers of metropolitan governments.

[57] For industrial uses, the "Rapport sur la sobriété hydrique des ICPE" notes the following ISO norms that target specifically industrial water uses: "ISO/TC 147 on water quality, ISO 22449-1:2020 concerning the use of recycled water in industrial cooling systems, and ISO 16075-1:2020, which provides guidelines for the use of treated wastewater, including a specific focus on industrial water reuse."

In a context where economic pressures on water preservation are pervasive, the civil society plays a key role. Even though they are less conventional, environmental and neighborhood association are actors in public action, just like experts and state agents do (Gardon *et al*., 2020) In Port-Jérôme, local associations monitor both DREAL and industrial actors. One neighborhood association explains:

> "People come to us with problems [in industrial water use]. Our first instinct is to turn to the *DREAL*. [...] Sometimes we also reach out to local authorities following alerts — whether it's the municipality or the metropolitan structures"

This excerpt clearly highlights collaborations with the state services in the logics to implement regulations. They rely on whistleblowing from workers and maintain informal exchanges with DREAL. It emphasizes the role of associations as intermediaries and watchdogs, where legal action can also come into play. One activist in the Port-Jérôme area recounts:

> "We went to court and did the water analysis. The DREAL was very pleased [...] because we did what they couldn't enforce."

These actors step in where state regulation fails. Lascoumes qualifies these local associations them as "external services of the ministries" (1994, p.193), even though their proximity to authorities varies with context. In PFAS-related conflicts in the Chemical Valley, mistrust has grown—especially regarding state-industry relationships and municipal inaction in cases of drinking water pollution.

Metropolitan areas, dotted with mixed tools due to their limited competency on industrial water governance, can take grips with the neo-corporatist *status quo*, and face struggles. In Port-Jérôme, the municipality supports industrial activity. All industrial and local authorities interviewed underline the long-lasting synergies between the industries and local economic development, as well as an absence of conflict around industrial development projects. In contrast, in the Chemical Valley, the Grand Lyon metropolitan area resorts to its competency – the distribution of drinking water – to target economic water use. Is this case a form of metropolitan resistance against the permissive system of industrial water governance? I cannot assess whether this belongs to a larger strategy, but I can discuss the practical effects it has. In practice, yes, it does challenge it. Since January 2025, the metropolitan area has implemented a new solidary and environmental pricing of drinking water, with a progressive system. The documentation describes it as a tool designed to "incentivize" the actors consuming the most water (Métropole du Grand Lyon, 2024, p.10). It is broken down in different categories to have a proportionate impact on smaller businesses with less consumption. The document introducing pricing states that this evolution "recognizes that not all uses of drinking water have the same

value. For example, 1 cubic meter of water used for a household's vital needs such as drinking and hygiene does not have the same value as 1 cubic meter used for leisure purposes or economic activities" (*ibid*., p.10). It targets a limited share of industrialists in the Chemical Valley. Yet, the reception from the economic world of this policy was heated. An industrial representative in the Chemical Valley declares:

> "Dogmatic policies... that aim to penalize the industrial sector through environmental measures will eventually reach their limits [...] Especially in Lyon, which is historically an industrial region."

Here, "dogmatic" likely targets the green-majority Grand Lyon governance since 2020, perceived as hostile to industrial development. A metropolitan official reflects on the public's perception:

> "[Upon our election], everyone was saying, 'they're degrowth advocates.' [...] But our message was: support transformation of local actors."

Industrialists lament a shift in public-private relations, criticizing the loss of collaborative, "win-win" governance in the Grand Lyon. The shift in electoral politics challenges the hegemonic compromise, according to which politics managing water should not harm economic viability and development. It is remarkable that, in essence, this policy claims and applies a financial solidarity among users. Yet, this application is – contrarily to water policies – negotiated in a limited way. This pricing was not discussed in any instance. It is not made to please sectoral interests. It is likely that the green party in the Grand Lyon– by what they represent and by their action – proves less inclined to strike a balance favoring economic development, prioritizing human health and environmental protection.

These struggles between economic development and water protection are further unveiled by participatory processes in industrial water governance.

2.2. The tensions of participatory processes

Industrial water governance is also shaped by participatory tools. They pertain to different units and operate at various scales. At the hydric-administrative levels, the river basin committee and the local water commissions are spaces of consultation on water politics. Port-Jérôme has one local water committee, and a

SAGE, while none has been formed on the Chemical Valley.[58] Looking at administrative boundaries, the regional and department levels display committees on industrial affairs (notably the CODERST[59]) but also on water (i.e., drought committees). At the industrial facilities level, there are also local monitoring commissions. During the installation of an industrial facility, associations may be consulted through regulatory channels or at the initiative of the businesses. State actors, water agencies, metropolitan areas, industrialists and the civil society navigate these scales.

Water is covered by territorialized institutions at a geographical scale (the river basin, the watershed), unlike other industrial input factors. The functions water has for different users, its characterization as a common good, favors a policy based on consultation for its governance. Therefore, studying the dynamics within these bodies is essential to understanding how water is governed and what role industrial actors play.

Far from neutral instruments, I analyze participatory devices in this section as both the expression and the stage of power relationships arising between stakeholders in industrial water governance. After an introduction of how these institutions can shape industrial water governance, I expand more on the power struggles at play. Beyond the open power confrontations, I also highlight how the silent act of rendering technical discussion excludes counterpowers to industrialists.

Shaping public action, easing the acceptance of measures

Looking at industrial water governance, the participatory instances are key in shaping governance, but also easing the acceptance of policies, anticipating resistance (Ostrom et al., 2003; Le Bourhis and Lascoumes, 2014). I shall introduce here the role of these instruments in those two domains.

Consultation first shapes and is a space for construction public action instruments. As we saw in the first chapter, water guiding documents rely on policy co-construction. The unfolding of participation procedures helps build and reinforce the spatial scales at which water policies are articulated and adapted. It enables the "territorialization" of central frameworks. Its extent is, however, dependent on local dynamics, administrative configurations, and political backing (Pasquier, 2013). The case of the SAGE is telling. While being a critical

[58] Several interviewees mentioned the adjacent SAGE Mont de l'Est Lyonnais, where associations, the metropolitan authority, and industrialists interact. I will refer to this consultation arena, as it is a space where tensions between these actors become visible.

[59] The CODERST is a Departmental Council for Environment and Health and Technological Risks. In this consultation instance, various actors – state services, associations, experts, local authorities - participate to give an opinion installation of industrial facilities installation.

tool for the SDAGE policy to come to life, a SAGE may never materialize when consensus is lacking to form a local water commission[60]. The Chemical Valley lacks a unified space for cross-sector dialogue on water usage.

Beyond these shaping logics, participatory devices also incorporate acceptability. Participation in water policy is as much a consultation, as a communication and prevention tool to ease the acceptance of the measures that could be seen as too coercive for industrialists (Petit, 2020, p.51). In that sense, participatory devices that render public action visible are also constructed to ease the acceptance of measures. State services emphasize communication and the importance of demonstrating that public actors are active. As a SAGE facilitator in Port-Jérôme stated:

> "It allows us to show that we're working with industrial stakeholders, but not only them. I've always repeated this in discussions: they're not the only ones being targeted. The strength of the SAGE is in gathering diverse actors. It's important for stakeholders to realize others are also involved."

It belongs to the idea of solidarity, the notion to share the burden, to which regulators pay caution to when implementing the regulations (Barbier et al., 2010), in order to ease the acceptance of measures. In a similar way, the dissemination of information is also thought to ease the acceptance of future regulations. It aims to inform stakeholders—especially industrialists—about policy implementation and upcoming changes, thus fostering better acceptance of instruments (*ibid*.).

Nonetheless, these processes to ease the acceptance do not remove all form of resistance. Power struggles are at play within institutions, with contestations of the order.

Open power struggles: solidarity and sharing the burden

Within participatory instances, open struggles might be at play. I find that water instances, because of their co-constructed character (Richard and Rieu, 2009), are spaces of confrontations. Consultation instances are a space to find alliances and defend interests. I note that solidarity, understood as fairness in the treatment, is a central theme of open struggles (Marette et al., 2006; Barbier et al., 2007).

[60] The SDAGE and the SAGE have different legal values. The SDAGE requires a compatibility for the policy documentation covered. It allowed for a certain flexibility and margin in the implementation. The SAGE for its part imposes a relationship of conformity to local planning documents. It is a strict legal obligation that it not negotiable.

Barbier *et al.* describe drought committee unfolding as a form of "conflictual cooperation," where each actor seeks to have their own objectives recognized, while framing them in broader, more legitimate terms (Barbier et al., 2007, p.18). The attempt to frame objectives as a larger issue could be observed with industrial representatives in the Chemical Valley, who mention seeking to establish common positions between farmers and industrial players. At the same time, industrialists also often denounce what they view as unequal treatment, especially in comparison with farmers. A representative of the Chamber of Commerce in the Chemical Valley region states:

> "I shouldn't be saying this as a representative of the Chamber of Commerce, but... we go after micropollutants in the industrial sector, while farmers are still dumping pesticides directly into nature."

Beyond water allocation, it is the distribution of regulatory constraints and environmental efforts that raises tensions. This could be understood as a lack of solidarity, or a certain inequality in the implementation of measures, or efforts in water preservation. The demand for a "fair" treatment of industrialists nourishes a narrative of under-representation among industrialists and their representatives. A representative of the Chamber of Commerce notes:

> "We're rarely listened to — the administrations are out of touch. They say, 'It doesn't matter, they're rich, we can ask them for anything.'"

Other industrial representatives regretted the limited number of voices for economic actors in the SAGE commissions. In Port-Jérôme for instance, industrialists have 2 representatives out of 38 representatives (Préfecture de la Seine-Maritime, 2023). On the one hand, this perception is echoed by interviewees and environmental associations from public authorities, who acknowledge the limited number of seats they retain, or the alliances that might play out in favor of water protection. Yet, neither the conflicts nor the decisions-making process unfolds necessarily in the dedicated participation arena. A Caux Seine Agglo employee explains:

> "We've never had any real clashes within this Local Water Commission. [...] During the meetings, things might not always be openly said. And in fact, big companies [..], sitting up there in the Oval office, they'll say, 'we don't agree with you..."

The "Oval Office" refers to the metropolitan presidency, suggesting that certain actors may access other, less visible spaces of power. The existence of "*adhocratic*" consultation centers – outside of consultation arenas planned by the law – calls to question the efficiency of participatory instances (Massardier, 2009). Negotiations happen outside of public arenas, and further fragment public actions (*ibid*.). Such *adhocratics*

meeting points might also be particularly strong in the context of Port-Jérôme, a company town, in which synergies between the metropolitan area and the industry are – as we saw – strong. In that sense, the conflicts happening within commissions, though telling, only portray a limited vision of the actual relationships.

Power struggles can be invisible within participatory instances, outside of the instance, and remain silent. I shall expand on this below.

Silent power struggles

Participation unfolds in arenas where actors do not all have the same voice or the same tools. Studying these dynamics is even more important as it is in these arenas that policies, and their compromises, can be shaped. I find two ways in which industrialists happen to retain power in consultation and institutions: the framing of information and the act of rendering technical.

First - about the information provided - consultation tools can be considered as a way to control out-of-sight information and by these means citizens (Gardon *et al.,* 2020, p. 96). Such control is regularly mentioned for consultation devices around industrial governance. The local monitoring commissions, that are only about information, are considered as a means "to canalize contestations on hazardous industrial projects' (Le Roux, 2021; Le Naour, 2024). Consultation happens in a context where industrialists master the information transmitted to the commissions, favored by a system of self-regulation that extends their power on disclosing information. Le Naour observes that the framing of communication from industrialists (and state services) towards the inhabitants revolves dominantly around accidental hazard, not chronic pollution. The inhabitants, for their part, regularly demand information about those chronic risks. Such framing participates in the answer to a "non-social demand" (2024, p.176). In the context of industrial consultation processes, industrialists retain a "framing power" (Morrisson et al, p. 2019), in the sense that they master the information provided. This potential framing power of industrialists is made visible in water commissions – where decisions happen – by their mastery of technical expertise.

Second, the use and control of technical expertise is an important tool. It is not so much about industrialists represented numerically in an instance, but about the role played up in that instance, and the space one might occupy. For a SAGE neighboring the Chemical Valley case, an environmental association explains:

> "The issue is that state services can't speak as freely or as often as an industrial representative—they're limited by their professional role. Meanwhile, as I was saying, the industrialist representative's strategy is clearly to speak as much as possible, have an opinion on everything, and make sure things drag on. And since the SAGE is a consultation body, we're required to take their input into account. So yes, even with just one or two people, they manage to slow things down a bit within the body."

The format of the meeting leaves space for consultation, that is both a strength of water politics and a weakness. The environmentalist comments how this industrial representative has the advantage of its technical expertise to slow the development of water protection policies. This strategy relies on mastering discourse and technical expertise. Industrialists and their representatives engage in a process of rendering the water topic technical (Lee, 2007). In a study on nature conservation in Indonesia, Li coins the concept of rendering technical. She defines it a set or practices that belong to the problematization of "a domain to be governed as an ineligible field with specifiable limits and particular characteristic" (ibid., 7). Two consequences of this process can be observed. First, this act of "rendering technical" creates and reinforces a boundary between the expert and the subject to expert directions. It marginalizes alternative approaches that do not master the language of expertise. Second, it also leads to render questions "nonpolitical". Such process seems at play in the industrial participatory arenas. Mastering knowledge for participation instances is a critical theme, acknowledge by all participants in these instances. All mention the time required to prepare the work conducted in these instances. Discussing these technical exclusions, Vergote and Petit (2016, p.10) analyze how the logics of indicators and quantifications (Marquet, 2014) reinforce a "structural secret" (Vaughan, 1999) in water. The scientific approach to water management creates structural barriers to several actors, and excludes alternative approaches to the discussion. In that context, even qualified actors might feel out of their depth. An employee of an environmental association mentions not to attend the departmental industrial committee anymore (the CODERST) in the Chemical Valley area, since "they lack technical expertise". The effects of this process of rendering the decision-making arenas too technical to tame participation are silent, but far from neutral, seeing the counterpart's role associations play. While some training efforts exist within the SAGE or local monitoring commissions, none are reported for the departmental industrial committees (CODERST).

2.3. Unveiling the unsustainable neo-corporatist compromises? Attributing responsibilities when industrial pollution emerges

Port-Jérôme and the Chemical Valley have both faced drinking water pollution from industrial activity. Throughout my interviews, I found that the case of industrial water pollution is a situation that unveils the socio-environmental unsustainability of the neo-corporatist governance model. In Port-Jérôme, the pollution was discovered in 2012 by accident during an official campaign analyzing water quality. It was traced to *the* only industrial users of the substance (nitromorphosoline)[61]. It led to the long-term closure of a well and two years of bottled water distribution by the metropolitan services. In Lyon, the widespread pollution of PFAS was unveiled by a media outburst in October 2022. Additionally, due to the widespread use of this substance, two industries were found to use them in their process: Daikin and Arkema. The cases highlight the interconnectivities created by water among its different functions: water as an absorptive flow of industrial activity, and as a resource to be shared, in these cases with drinking water provision.

Just like industrial risk management, industrial governance water seems characterized by sharp variations between periods of inactivity and absence of mobilization and moments of conflicts and civil mobilization (Bécot et Le Naour, 2023). On a daily basis, industrial water use follows its path, outside of the public eyes. Industrial water pollutions trigger mobilizations and publicizes the limits of the compromises made during routine times.

I argue here that the unsustainability of the models – part of the governance system – are exemplified by these times of crisis, thanks to the materialization and interconnectivities created by water. Three main dimensions are explored: fragilities of polycentric governance, the limited effectiveness of regulatory instruments, and the political tensions behind the polluter-pays principle.

From polycentric struggles to publicization strategies

These cases show the difficulties of a polycentric system requiring coordination among multiple actors. The DREAL oversees industrial surveillance, the regional health agency monitors public health, and municipalities manage drinking water provision. But there is no formal communication channel to ensure coordination between state services and metropolitan governments. In Lyon, this absence gave way to the creation of a crisis "PFAS committee" by the DREAL to gather stakeholders. In both cases, the regional health agency is blamed

[61] Nitromophosoline is an organic compound that present several risks to human health, depending on its concentration: toxicity, genotoxicity, carcinogenic (ANSES, 2012).

by local authorities for its lack of communication with metropolitan areas and inaction. This absence of coordination between the state services and local governments – though accepted in daily management – proves a struggle in this situation. This results in municipalities reporting being alone in the management of drinking water pollution, while standing at the forefront with the inhabitants affected by the pollution. One should note however that the state services interviewed mention taking action in both cases. The problems seem to lie in the extent of actions perceived (i.e., the metropolitan areas perceive state actions as limited, and too compliant with the industrialists), but also the communication between both parties (with no formal channel, actors are not mutually coordinating and informing each other of their action). The polycentricity of the model does not prove efficient in that case. Municipalities resort to strategies out of the regular industrial water governance realm.

The unsustainability of the status quo is primarily revealed by the publicization strategies of the drinking water pollution, in order to put pressure on industrialists but also state actors (Gilbert and Henry, 2012). While in Port-Jérôme, their attempts at publicization failed, the PFAS theme was more publicized in the Grand Lyon[62] metropolitan area. The metropolitan area stands by this strategy of power struggle. An interviewee explains:

> "We have the dialogue and the power struggles, [...], we join the fight, denounce, and ask questions to the state so that the economic actor is held accountable. And in this fight, we are supported by NGOs, residents' collectives, and even workers' unions. And it's about creating the power dynamics."

Legal action becomes an additional response to impasses—initiated in Lyon, and avoided in Port-Jérôme through negotiation. As states a Grand Lyon metropolitan representative, "we're in a real conflict that couldn't be resolved in any other way than through legal action". Alongside the media, the judicial sphere is expanded as an arena of publicization for the PFAS management (Gilbert and Henry, 2012, p.43).

Limits of regulatory instruments

Despite extensive regulation, pollution continues to emerge unexpectedly. Drinking water pollutions cases come to challenges the idea that more instruments equal more security. The PFAS scandal reveals how regulation profusion can mask latent risks and depoliticize environmental problems (Halpern *et al*., 2014; Swyngedouw, 2018). Industrial pollution reintroduces uncertainty into a supposedly stabilized system.

[62] This different in publicization could also be attributed to the widespread nature of the pollution for PFAS, contrarily to the pointed and local pollution for Port-Jérôme.

Trade-offs between economic development and environmental protection (even at the cost of public health) - become explicit. In the case of Port-Jérôme, a metropolitan agent underlined that the industry responsible for pollution was the second largest employer, which prevented any offensive communication from their part. In the case of the Chemical Valley, the metropolitan services also denounced the state and industrialists' synergies. Regulations thus appear limited by economic dependence.

The effectiveness of participatory instruments is also questioned. In Lyon, a resident association discovered Arkema had long known the risks of PFAS, despite ongoing outreach and visits.

> "There were manufacturing processes in the past that were extremely dangerous [...] Most of these things have been stopped. And for us, [...] the factory was safer for the residents. A good neighbor, really. Until the revelation came. We realized that, for example... In the United States, Arkema was warned in the early 2000s [...] that they should no longer use [PFAS] because it was dangerous [for the population]. They continued to use it in Pierre-Bénite until 2016. This is where we see all the duplicity. During that time, I had meetings in local monitoring commissions, I had encounters... I made visits. I was even part of the program established by Arkema, ... There were associations that came to visit the factory, to see the evolution of the techniques."

It also comes as a reminder of the nature of communication transmitted in the participatory instances on industrial risks. In the Chemical Valley, the PFAS pollution resulted in a certain mistrust of the resident association towards industrialists and the state services in the protection of health and the environment. In this context, alternative approaches emerge.

In that regard, the Grand Lyon metropolitan area commissioned a study to the Eco-Citizen Institute, to assess the exposure and extent of PFAS pollution on the inhabitants. During the interview, the Eco-Citizen Institute agent specified that they do not claim to discard "official expertise", but to take up a complementary role. Their scientific protocol is co-constructed with participants in their opened workshops. The goals are to answer the questions participants have on their exposure to pollution, beyond the official threshold's conversations. The regulations are not sufficient, and these cases prove how they might fail to ensure the safety of inhabitants. As the interviewee from the Eco-Citizen Institute puts it:

> "'Everything is fine, or rather, don't worry, it's all being handled by the regional health agency. The issue is perfectly under control'. It's really the classic discourse of the 1960s, where progress is meant for the

well-being of humanity and everything has been planned. What [the participants] want is for it to be written down somewhere, that 'I'm worried [...]. That I'm worried for my children.' "

The Eco-Citizen Institute approach has far more than a scientific role to play. It is also a matter of restoring citizen's trust through the production of knowledge that answers their concerns for health (Le Naour, 2024, p. 186).

Attributing responsibility, enacting solidarity

Both municipalities faced financial burdens: distributing bottled water, upgrading treatment facilities, and initiating depollution. The materialization of water uses through the infrastructure and its multiple uses are an important vector to establish – at least partially - the costs of industrial pollution. The effects of carbon emissions are comparatively, harder to assess. But assigning responsibility remains complex. In Port-Jérôme, the unique molecule used made attribution straightforward to one industrial facility. In Lyon, diffuse PFAS use complicates the picture. Two main emitters were located, but PFAS are also widely used in other widespread purposes[63]. This crack is infiltrated by lobbying attempts. Associations report denial, and knowledge is selectively produced or withheld (Henry, 2017). This produces a dilution of responsibility, just like pollution is diluted in the river waterflow. Pollution by industries is solved through dilution: "they cause harm at trace quantities already present in the environment and bodies", or at least frame it as such (Liboiron, 2015, p.17). The targeted industrialist's responsibility is in the process of being attributed. In this context, the dilution of this responsibility is observed by interviewees. Beyond the case of Lyon, the PFAS system interrogates more broadly the application of fundamental principles. A Grand Lyon elected official states:

> "The State relies solely on the regulatory framework, and neither the precautionary principle nor the polluter-pays principle is applied in France. And we, the local authorities, are left with the burden of both proving responsibility, repairing environmental damage, and setting up systems to provide compliant water."

The question underlying responsibility is also one of solidarity: who has to take action? The struggle to apply the polluter pay principle are not without reminding the limits of the water governance fiscal model (Howarth, 2009; Barone and Mayaux, 2019, p.58; Sanchez Tranchon and Lefaive, 2024; Carré and Markovitch, 2024)

[63] The actors questioning Arkema and Daikin responsibility often mention the use of PFAS in firefighting foam. They claim that the PFAS could come from regular fire drill in industrial complex, or from the industrial area's port fire in 1987.

Conclusion of the chapter

The industrial water use realm is simultaneously governed by the fields of industrial (DREAL), water (Water agencies) and local governance (metropolitan areas). These actors' resort to a variety of tools, balancing incentives and constraints, standing in the midst of contradictory goals. This is further complemented by participatory instances, in which industrialists relate to the public authorities, the civil society, and other end-users. Even though the sector is framed by a large number of regulations, the dissection of policy instruments unveils attempts or pressures to balance economic development and water preservation. It provides economic actors advantages in the instances, notably through the affirmation of a given expertise and legitimacy games. In this context, the civil society is sidelined. While the state services are perceived by economic actors in a relatively similar manner in both empirics, the metropolitan-industrialists relationships differ. In Port-Jérôme, one remains in this long-lasting synergy system. In Lyon, the metropolitan area walks on a tightrope. While supporting industrial development, the green majority also defends transformation in the industrial water use. As the classic win-win situation is questioned, it plunges the municipality into turmoil with a share of industrialists. The case of industrial pollution of drinking water makes these governance stakes acute. Water, as simultaneously a resource and a recipient of effluent catalyzes the limits of industry-environment relations. Differently from other scopes of industrial impact, such as air and land, water is also dotted with instances for its collective management where struggles can play out.

Chapter 3. A green reindustrialization accounting for water? A transition without transformations

> "Reusing water isn't innovation. It's something we have to do. And that's what I was saying earlier—the problem with communications people is that they try to pass off mandatory water treatment as innovation. And, if you will, that kind of rubs us the wrong way. [...] Basically, that's their doublespeak: 'oh yes, but we're going to treat water better than others.' Sure, they might treat it better because they'll have brand new facilities, unlike [another industry] which still has old facilities they didn't want to maintain [...]. But let's stop calling it innovation—that's just not true. We're not doing anything better."
>
> – Neighborhood association representative, Port Jérôme area

This last chapter explores the extent of change in industrial water governance, in the context of green transitions and reindustrialization. "We're not doing anything better," says this interviewee. While he acknowledged earlier in the conversation that there have been improvements in industrial water management since the 1990s, he remains skeptical of the current projects promoting water reuse and their supposed "innovative" character. He questions the depth of change in industrial practices—a theme that this chapter seeks to interrogate. According to interviewees, media accounts, and policy documents, the 2022 drought marked a shift in how water is perceived for industrial use, highlighting its vulnerability as a resource. However, disagreements persist as to whether industrial actors were genuinely proactive or simply complied with regulations to avoid sanctions. This is what the interviewee refers to as "mandatory water treatment": industrial actors are compelled by state actors and regulations to reduce their consumption. Additionally, the emergence of the notion of "hydric sufficiency" and the promotion of technological approaches such as water reuse and industrial ecology raise the question of whether industrial water governance is undergoing deeper transformations toward sufficiency. This is particularly relevant since efficiency measures alone may not be sufficient (Davidson, 2019; Lorek and Fuchs, 2013), and sufficiency implies more substantial changes—potentially including reductions in production. This intersects with another priority beyond green transitions: reindustrialization, which could itself increase pressure on water consumption. Under these dual

political pressures, the question becomes: are we witnessing a change[64] in the way industrial water use is governed? And if so, what is its extent?

Several conceptual debates are at play here to discuss the extent of change: sufficiency vs. efficiency, weak vs. strong sustainability. Covering these approaches, I draw in this chapter on the sustainability transitions or transformation debate. The two terms are often used interchangeably to depict change. Yet, some authors make a distinction between them (Hölscher et al., 2018). To put it simply, transitions can be understood as social, institutional, and technological change in societal sub-systems (such as energy, mobility, or water). Transformations, for their part, concern large-scale change processes and have implications for justice within system change (Raworth, 2012). I understand transitions here as one dimension of transformation. The latter involves a deeper systemic change. As I will develop, I associate transformation with sufficiency and a strong sustainability approach. A hydric transition, for its part, tends to favor efficiency, in a weak sustainability approach. Behind these concepts lies a set of narratives: the 2022 drought, green reindustrialization, and hydric sufficiency. These changes and narratives circulate across scales. From national state-sponsored reindustrialization policy and the Water Plan to their local implementations, transition processes are often discontinuous and fragmented. This highlights the deeply multi-scalar nature of the transition (Bulkeley, 2005). Far from being an abstract notion, current representations shape the future, what I shall treat as imaginaries. Imaginaries play an important role in shaping solutions (Feola et al., 2021). I will study the performative powers, impacts of imaginaries and visions of transitions conveyed through political decisions and instruments.

In this chapter, I argue that despite transformative narratives, the most significant shifts occur at the discursive level. I observe continuities in industrial practices, with changes largely driven by constraints. The transformation appears incremental and aligns more with a logic of weak sustainability, sustaining the *status quo*. A real transformation of water governance toward a strong sustainability approach is impeded by the absence of a systemic transformation of the wider industrial system and logics, still dominated by a growth-oriented paradigm.

This chapter is structured in three parts. First, I examine the so-called 2022 awakening and nuance the changes it spurred in industrial practices. Second, I explore the concept of hydric sufficiency, a consequence of the 2022 drought. Despite its radical wording, this notion depoliticizes sufficiency and leaves it in a grey zone, supporting the *status quo*. Third, I examine the trade-offs of green transitions and

[64] Here, I understand change as a modification of industrial practices to decrease the pressures exerted on water by their activity.

reindustrialization. I find that these trade-offs illustrate the absence of a deep transformation in the relationship to the resource. They maintain a growth-oriented logic guided by the reliance on innovation and technological solutions and excluding any reflection on planetary boundaries. Doing so, it further reinforces existing power dynamics.

3.1. "Water is lacking", the 2022 awakening?

Since when has water become a concern for industrialists? This is a question I asked all interviewees. Regardless of how they assess the extent of change, the 2022 drought is described by the vast majority as a turning point for industrial water governance. Its effects—highlighting both water scarcity and the impacts of climate change—are frequently cited as key drivers of this transformation. This section aims to identify and situate the origins of this so-called change. Tracing its origin also helps to better understand its meaning and depth.

Rather than accepting the idea of a sudden collective awakening, I offer a more nuanced view of the 2022 drought as a pivotal moment. I argue that awareness of water vulnerability remains limited and is not the main driver of change. Instead, it is the costs of the drought, due to the enforcement of drought decrees by the state services that transformed the effects of water use.

I will first examine how perceptions of water scarcity are tempered by the perceived abundance of large rivers, as discussed in Chapter 1. Second, I will show that it is not the drought's direct effects that triggered change, but rather the state's response—particularly the application of regulatory measures—that increased the costs of water use for industrial actors.

A 2022 widely shared experience?

The 2022 drought in France stood out for its intensity and its unprecedented geographical reach—nearly all departments were affected by restrictions measures and decrees (Berne, 2023). Its impacts were felt across all sectors, though industrialists appeared less vulnerable than others (Bertrand et al., 2023). Can the 2022 drought be then qualified as a widely shared experience, looking at the cases of the Chemical Valley and Port-Jérôme? I answer below that - despite the perceived effects of the drought – the socio-political construction of the river as an abundant body hampered awareness to fully happen.

Despite being described as a significant episode, it did not unfold as threatening in the Chemical Valley and Port-Jérôme, due to their abstractions in large rivers. Both the Chemical Valley and Port-Jérôme had experienced direct or remote drought episodes before. In this sense, it is not seen as the first drought episode, but rather as a catalyst. An agent of a competitiveness cluster in the Chemical Valley states that "There was the 2022 drought, it had a huge role [in raising awareness on water scarcity even more]". An industrialist in Port-Jérôme mentions how the awareness on water scarcity "accelerated with the 2022 drought episode". Yet the two industrial complexes I study were only marginally affected. The larger rivers from which they draw water—the Seine and the Rhône—were dominantly exempted from drought restrictions, as they are not considered bodies under pressure[65].

The framing of large rivers as abundant – explained in the first chapter – is important to understand the effects of this drought decree's relativization of water body vulnerability. On the one hand, the zoning system is inherent to the drought decree system and the notion of territorialization: it is constituted of zoning and exemptions, to allow for an application of restrictions that sticks as much as possible to the local state of the resource (Barbier et al, 2010, p.16). When applied, it signals the vulnerability of the water body (even though it can be an object of contestations) (*ibid*.). On the other hand, the effect of the drought decree's repeated exemption of large rivers demonstrates the governmental view that these water bodies are not vulnerable.

This is also what might explain the actual limited awareness that regulators observe when it comes to the drought. In Port-Jérôme, public actors highlight difficulties in conducting prevention in a context where water is perceived as abundant. In Lyon, DREAL services note that some industrialists in the Chemical Valley do not feel significantly affected by drought risks. As an Auvergne-Rhône-Alpes DREAL agent puts:

> "[The Chemical Valley industrialists] don't necessarily feel concerned because they draw water from the Rhône. And it's unlikely that the Rhône would experience drought. So, they don't really see the point of taking action."

This quote highlights three elements. First, the assessment that the industrialists do not feel targeted in this area since they are abstracting water from the Rhône. Second, the fact that this explanation also seems

[65] I identify two key factors that could explain a certain awareness, in spite of the absence of drought restriction measures. First, actors such as state agencies operate at broader territorial scales (departmental or regional), allowing them to observe drought-related struggles across multiple areas. Second, the widespread nature of the drought affected other industrial facilities outside of the industrial complex, including those within the same corporate groups. Many industrial facilities belong to larger national or international entities. Even if water scarcity was not a local issue, it became a strategic concern at the group level.

endorsed by the DREAL agent, who states that it is unlikely that the Rhône would undergo a drought. Yet, as discussed in the first chapter, the Rhône also presents vulnerability, even though on a larger timescale. Third, the framing: the vulnerability of the river to droughts, despite the 2022 episode, is far from being fully integrated by public agents and industrial users. If it is not for the intrinsic vulnerability of the river, in what does the so-called 2022 change lie ? I shall expand below on the role of regulations.

Water scarcity or water costs? The role of the regulatory environment

When questioned, industrialists often refer to past efforts in water preservation, casting doubt on the idea of a 2022 "shock", and emphasizing their proactivity in the process of water preservation. I find however that the change rather came from the regulatory side, as the tightening of regulations presented costs and risks for industrial activity to continue. The awareness is not on the vulnerability of water, but on the vulnerability of the industrial sector with relation to water sources.

When asked about the 2022 awakening, industrialists often stress that water-saving efforts predated the drought. An agent from an industrial federation in the Chemical Valley noted:

> "The reduction of water withdrawals is something that chemical facilities have already been implementing for some time. However, the turning point that made water management a truly pressing issue was the 2022 drought."

The evidence of existing progress can be supported by other sources (Perrot and Pilato, 2023, p.16; Arambourou *et al.*,2024, p.11). The narrative of industrialists as anchored in a "continuous amelioration" of their practices is – as we saw in chapter 2 – pervasive. It is embraced by industrial actors, but also public authorities. In Port-Jérôme, the industrial water plant is mentioned across all actors to underline a historical care for the resource, and an attention for its preservation. It is often omitted, however, that this industrial water plant was also constructed in reaction to salinization risks, due to an overexploitation of groundwater in the industrial area (Catoire and Lecornu, 1972). This valorization of "continuous amelioration" also participates in a corporate image and hence an act of communication where good practices are valued (Bowen and Aragon-Correa, 2014). It also posits a functioning self-regulation of industrialists when it comes to water uses. As we saw in chapter 2, this is also tinged with limits. An approach through the sole continuous amelioration frame also masks the role of the state services, critical in driving change.

The existence of a "2022 episode" – at least for these industrial complexes, both located around large rivers – appears to trace back from the state response to the crisis[66]. Though water has long been on the radar of industrialists, one may question how seriously it was treated. If it was so well anticipated, why was the 2022 drought still a shock for them? The role played by state-led regulations is illustrated by a Rhône-Mediterranean Water Agency agent:

> "When the State services said 'Stop – you can't produce anymore because there's no more water left for ecosystems or aquatic life,' that marked a turning point. [...] In that moment, the State really acted as a guardian of the public interest, and the industrial sector had no choice but to adapt. People started asking: if this kind of drought happens again, how can we keep producing? How do we anticipate this? Without the drought of 2022, water would likely have remained a background issue – just one of many operational concerns, not a real strategic priority [...] But they really woke up after that episode, when things got complicated everywhere."

This excerpt highlights the interplay between the State's action and the resulting changes by industrial actors. It is possible that without this pressure, water would have remained a secondary concern. The term "background" invites a reconsideration of how significant earlier improvements truly were. From that, it is rather a reactive approach, in the face of a state reasserting its authority through binding rules. In that sense, the assertion of water scarcity called to reassert the State's role in managing industrial water use. The construction of scarcity in that context is not new (Woodhouse and Muller, 2017), a topic I shall come back to in the third section of this chapter. It is likely that the perception of a water crisis, of which the extent was enacted by state action, was perceived by industrialists as a threat.

What shape did this state action take? During the drought, decrees were taken with the aforementioned exemptions from restrictions measures. In the aftermath, the DREAL imposed new regulations on some industrial areas in both industrial complexes: the *PSH* in the case of the Chemical Valley and the *Audit Eau* in the Normandie region. These two instruments are territorial, they were developed autonomously by each DREAL, pre-2022. In both cases, these instruments were mandatory for some industry in precise areas that were perceived as more vulnerable to drought. Post-2022, both DREALs demanded industrial facilities that are largely consuming to apply these instruments. These two instruments demand an assessment of the water use of each industrial facility, and progress. Based on measurements, if industries make certain efforts towards the reduction of intakes (e.g., 20% for the Audit Eau), they can have exemptions in case

[66] The roots of state action for the 2022 drought cannot be precisely traced. It is likely that the extent of the effects, and the risk of emerging usage conflicts favored them.

of a future drought decree that could constrain them. Both DREALs describe these instruments as a way for industrialists to "raise awareness" on their consumption.

The way these instruments are described also relates to the notion of solidarity of French water politics. A DREAL agent from the Auvergne-Rhône-Alpes region explains:

> "So, we go to [industrialists] to say: 'Hold on, you're also contributing to water consumption, there are users upstream who also need water. You do have a stake in this, and it's in your interest to take action.'"

In that sense, the framing seems to account for downstream uses. The notion of equal treatment, and fairness in the treatment among users is essential here. Just like it is for the drought decree (Barbier *et al.* 2007; Barbier *et al*. 2010).

Can these new instruments be considered as an instance of change? This seems to showcase a case of layering (Mahoney and Thelen, 2010). New rules are added to the old ones. Is it opening the way for incremental change ? On the one hand, the PSH and Audit Eau are considered to have a positive effect, but not necessarily on intakes. It is rather a tool of diagnosis, at the disposal of the DREAL and the industrialist. On the other hand, its format also recalls a certain continuity with the way state services relate to industrialists, seeking to maintain a win-win situation for industrialists and the environment. The perspective on instruments allows us to map the extent of change (Halpern *et al*., 2019). These tools witness limited expected reductions in intakes proposed by industrialists, which is required to be exempted from measures in case of a drought decree. This logic mentioned by an interviewee from the municipality is also noticed at the national level (Couvreur *et al*., 2023, 23). Layering, though it can produce change, can also act in favor of stability as could Barone (2025) and Mayaux (2021) emphasize it in their empirical studies on water governance cases.

The notion and extent of change in industrial water use is further questioned by the concept of "hydric sufficiency", and the real meaning it takes up.

3.2. The concept of "hydric sufficiency": are the industries really transforming?

The notion of "hydric sufficiency" is at the forefront of the industrial water use policy. State services and local authorities often refer to this goal. It is also the name adopted by certain instruments, such as the "hydric

sufficiency" plan (PSH) implemented by the Auvergne-Rhône-Alpes DREAL, or the nationwide water-use diagnosis system by sector. The relatively recent emergence of the term can also be confirmed by a brief textual analysis of the French press[67]. The first occurrence appears in 2019, but 94% of the articles that mention the term are dated post-2023. A surge is observed in 2023, the year the nationwide Water Plan was announced. This plan is among the key terms associated with the articles, alongside "ecological transition" and "industrial facility".

Let us open the box of "hydric sufficiency", as the terminology chosen matters to understand the tradeoffs and change to occur (De Jong *et al,* 2015, p.22). Generally, it is a term endowed with a notion of radicalism, that could call for production decrease (Jungell-Michelsson and Heikkurinen, 2022; Audren de Kerdrel and Fontaine, 2020) and shift the economic order broadly. How can this notion emerge to discuss industrial practices that are growth-oriented and favor efficiency (Niessen and Bocken, 2021)? Does it imply a change as radical as it sounds?

I find that the use of the term hydric sufficiency is generally used in a fuzzy way, confusing it with efficiency practices. In this approach, sufficiency is depoliticized, and thus emptied of its radical meaning. There is no reflection on needs, distributive justice or long-term planning. In that respect, I argue that the concept of hydric sufficiency did not drive transformations in industrial practices. At most, it is an incremental hydric transition, failing to challenge the *status quo*.

In this section, I shall first dissect the fuzzy approach to sufficiency in "hydric sufficiency". I will then summarize the main characteristics of that concept and introduce the challenges it raises.

A fuzzy approach to sufficiency

Sufficiency is a term with a radical potential. Yet, I find that its appropriation under the banner of "hydric sufficiency" in the context of industrial water use dilutes this term at the profit of a depoliticization. I will introduce the meaning of sufficiency, contrasting it with efficiency. I find that in the field, sufficiency and efficiency are blended. It tends to favor a depoliticization of the term.

[67] This analysis was conducted through a Factiva search. I prompted the word "sobriété hydrique" to be included in the text, within the general French press. Even though I reckon that the browser may have its limits, and that the press does not involve other government report that have been used, I stand by the fact that the press content is indicative of the general debate/state of a question.

What does sufficiency mean? This term has been subject to various interpretations. In their literature review on the concept, Jungell-Michelsson and Heikkurinen confirm this observation (2022), finding that sufficiency remains characterized by its vagueness and difficult operationalization. Its understanding varies with economic scales and actors, around the micro- or macroeconomic scale (*ibid.*). For production purposes, they observe that sufficiency is often understood "as calls for a paradigm shift in business logic, as well as in an abstract aspiration for alternative imaginaries to organize the economy". They also notice that sufficiency is also widely understood as a radical term, involving possible decrease in production. Despite various interpretations, the Intergovernmental Panel on Climate Change (IPCC) stabilized a definition of sufficiency, to which I shall resort to compare with "hydric sufficiency":

> "Sufficiency differs from efficiency: sufficiency is about long-term actions driven by non-technological solutions, which consume less energy in absolute terms; efficiency, in contrast, is about continuous short-term marginal technological improvements. Sufficiency policies are a set of measures and daily practices that avoid demand for energy, materials, land and water while delivering human wellbeing-for-all within planetary boundaries." (IPCC, 2022, p.114).

This framing distinguishes sufficiency from efficiency in goals (long-term vs. short-term), mechanisms (non-tech vs. tech), and adds the idea of limits (human well-being and planetary boundaries). The notions of "long-term" and "measures and daily practices" refer to a notion of sufficiency that goes beyond an individual approach. In that regard, sufficiency shall be seen as a political project to be mainstreamed (Saheb, 2024). Sufficiency pertains to a strong sustainability approach (Brullot et al., 2017), involving a transformation of the economic model. Efficiency on its side pertains to a weak sustainability vision, according to which innovations and growth can compensate for negative externalities.

In the field, two actors provided a definition of sufficiency that aligns with this strong sustainability approach.

> "Sufficiency is necessarily a key element of degrowth. So, the idea for us is degrowth. [...] Do we really need to produce so many cars every hour? Do we need so many washing machines per hour? Or so many consumer goods?" – a local association in Port-Jérôme

> "[A sufficient industry] means only what's needed for your production tool. [...] If you're serving a market in China, maybe there's no need for you to be here. But if you're meeting local needs—I'm going to be very caricatural—but say, transforming wheat chaff into... insulating panels, well yes, because the wheat chaff comes from the Forez plain." – a political representative of the Lyon Metropolitan Area

Both actors call to interrogate the needs, the *enoughness* that is required by consumption. They refer to the minimum required to ensure human well-being, while also questioning the maximum threshold (Spengler, 2016), that can be understood as the planetary boundary. This view would imply a definition of needs, that remains however quite vague. The notion of degrowth, discussing decrease in production, is introduced by the local association representative.

In the field, the meaning taken up by sufficiency appears diluted, confused and melted with efficiency.

To analyze it, let's first have a look at what policies are covered by "hydric sufficiency". I resort to two main sources: a national report on hydric sufficiency and the interviews conducted in the field. A report on "industrial hydric sufficiency" produced by state agents summarizes several improvements in that domain in France under six main categories: Know and measure water flows; Optimize processes; Reduce, reuse, recycle; Estimate the true cost of water; Implement a water management system; Mainstream the use of water footprinting (Couvreur *et al*., 2023, p.51). It comes with other practices to a lesser extent: crisis preparedness, decrease of summer production, water stocking (*ibid*.). Similar trends could be observed in both of the empirical cases, with a clear direction towards synergies and reuse processes. In both cases, studies assess the potential for industrial ecology and reuse development. In Port-Jérôme, the new industries settling incorporate and communicate on the processes to reuse water (Eastman, 2024). All of these measures to preserve the resource pertain both to efficiency and sufficiency. In the interviews conducted in both fieldworks, sufficiency is described in the following ways :

> "For me, sufficiency means withdrawing only what we need. No waste, tackling leaks. And beyond that, I only withdraw what I need, and I also have a process that allows me to maximize the efficiency and use of water." – an industrialist from Port-Jérôme
>
> "Water sufficiency is linked to the requirements that may be imposed by the inspection of classified installations, particularly the DREAL, through certain obligations tied to water sufficiency plans requested from industrial actors—especially when they wish, I won't say exactly to 'derogate,' but to assert their longstanding good practices in water savings, in order to continue operating efficiently, even during somewhat challenging periods when water reserves are low and drought regulations impose withdrawal limits." – an industrial representative from the Chemical Valley
>
> "Sufficiency is a response to the water stress [...]. When we talk about sufficiency, it means consuming less water. And consuming less water can involve water reuse (REUT), or it can mean modifying my process so that it consumes less." – an actor from the innovation sector, Chemical Valley

> "On one hand, we will focus on sufficiency, but on the other hand, there also needs to be consumption because of development. [...] Sufficiency doesn't prevent development, but development needs to be done in a sustainable way." – an economic actor, Port-Jérôme

These four quotes encapsulate the main themes that could come up when discussing hydric sufficiency. They seem far from the radical sufficiency approach. I shall expand below on the five main characteristics that underpin the appropriation of this concept.

Characterizing hydric sufficiency

From the interviews, documentation on that topic (the Water Plan and the report on industrial hydric sufficiency commanded by the Ecological Transition Ministry), and a few pieces of literature on that topic, I identify five main characteristics to hydric sufficiency: a mainly crisis-driven response (1); a blend between efficiency and sufficiency (2); a fuzzy definition of needs (3); a technical approach (4); a solely resource oriented perspective (5)

First, hydric sufficiency is conceived as a crisis-response, far from the long-term planning that is involved by a strong sustainability approach to sufficiency. Hydric sufficiency is captured through a short-term vision, a "response to water stress" as an interviewee states. The 2023 Water Plan itself was a reaction to the 2022 drought, setting short-and medium-term goals—such as a 10% reduction in water use by 2030 (Audren de Kerdrel and Fontaine, 2020). This policy is rooted in what Vergote and Petit describe as "*a gestion de crise à froid*" (2016). In their analysis of a local instrument responding to water scarcity, they observe that the planning followed a "transitory" logic. It was based on the assumption that "abundance might come back" (2016, p.12). The Water Plan, with its short-term logic, reflects similar tendencies.

Second, hydric sufficiency and hydric efficiency are used jointly—often interchangeably. The authors of the industrial hydric sufficiency report observe that "sufficiency, efficiency, and reuse" are frequently confused by both industrialists and regulators (Couvreur *et al*., 2023, p.45). While the report does not clarify these distinctions, it asserts that sufficiency concerns reducing water needs at the source—i.e., minimizing the volume withdrawn for production (*ibid*., 8). In the Water Plan speech, President Macron referred to a "plan for water sufficiency and efficiency in the long run". Yet in both the report and the speech, sufficiency never goes beyond the notion of reducing water use. Nothing seems to truly diverge from "longstanding" practices (Trottier, 2023, p.3). It combines reductions in environmental withdrawals and process consumption, and sometimes includes innovation (e.g., REUT). In the industry, sustainability measures mainly revolve around resource efficiency and consistency, around technological innovation (Niessen et Bocken, 2021, p.1092).

While the combination of efficiency and sufficiency appears necessary for conducting transitions, the issue is that sufficiency tends to be sidelined in favor of efficiency policies. Sufficiency is even more important when it comes to water uses, as efficiency on its own risks to produce rebound effects the progress conducted.

Third, hydric sufficiency does not address the needs of production. The notion of needs—or a minimal required threshold—is either absent or framed in individual terms at the industrial level, without any questioning of the nature of production itself. Instead, as with the Port-Jérôme industrialist, needs are defined as what is necessary for production. But who defines the true needs of this production in a systematic way? The needs that are targeted by sufficiency are not about the requirements for production to continue. Instead, these needs ask the questions of the necessity of this production at a societal level. The focus on efficiency and technological innovation are identified as barriers to "reflection of consumption levels maintained through business" (Lorek and Fuchs, 2013). Does this production justify the right of corporations to withdraw water, a shared common good (Davidson, 2019)? The limitations of a hydric transition detached from broader systemic change become apparent—transformation cannot occur without structural shifts (Hölscher *et al.*, 2018). Sufficiency underpins avoidance and frugality. Such characteristics are incompatible with an increasing profitability approach, contrarily to efficiency that allows to sustain them (Schmidhäuser et al., 2024, 12).

Fourth, hydric sufficiency is limited to a technical question: what are the best kinds of technologies to optimize water use? It remains in that regard a topic tackled by experts and technicians, in the hands of industrialists. It comes to further the process of rendering technical (Li, 2007) exposed in chapter 2. Doing so, it frames water governance under the lens of expertise. Governance, even though it is a pillar of the Water Plan, was not included in conversations around hydric sufficiency. The Plan demanded that each watershed shall be dotted with a local water instance and a "territorialized political project on the sharing of the resource" ("Plan Eau", 2023, p.11). Port-Jérôme, already covered by a local water commission, does not display many governance or democratic concerns on the industrial projects developed. In Chemical Valley, a local water commission does not appear around the corner. In that respect, hydric sufficiency is a depoliticized term: the sphere of the political is refrained through a techno-managerial dispositive (Swyngedouw, 2018, xv).

Fifth, hydric sufficiency is resource-oriented. This concept puts water availability at the core. Quality and ecosystem are mentioned, but as a corollary. Scholars have already analyzed how the narrative of scarcity has been used to justify a state response (Swyngedouw, 1999; Woodhouse and Muller, 2017, p.14). This focus on the provision of water as the main goal also has the benefit of sustaining the *status quo*. Approaching water through ecosystems and absorptive capacities could question fully the uses of industrialists, as chronic pressures on the resource and artificialization are often the corollary of industrial development.

Based on that definition, hydric sufficiency amounts to another instance of "climatization" of public action (Semal, 2017). In this vision, climate change is becoming a paradigmatic theme in the discourses, practices, and policies, and consequently shapes organizations and policy tools (Aykut and Maertens, 2021). While some degree of climatization is associated with transition pathways, the extent of practical change induced by those narratives is not guaranteed. The concept of hydric sufficiency incorporates the effects of climate change and overexploitation (in this case, solely water scarcity) and shapes the regulators and industrialists' practices and discourses. The variety of tools and the widespread use of the word "sufficiency" supports that interpretation. As the discourse unfolds, the practices seem – again – to stand still. The change is lesser than what could announce the word sufficiency for a firm. To examine it, one can resort to the conceptual frameworks for sufficiency strategies within firms by Schmidhäuser *et al.* (2024). It has three levels (*ibid.*, p.13), going from lowest to highest integration of planetary boundaries in company strategies. The lowest is individual sufficiency, understood as protecting the company's viability. The second is industrial sufficiency ("integrating a new concept of value creating beyond monetary scales, including common good"). The third is societal sufficiency ("acting within the socio-ecologically acceptable levels of planetary boundaries"). In the current measures associated with hydric sufficiency, most of them belong to the lowest level, protecting the company viability, being the enactment of measures to protect water aligned with efficiency strategies. Within the industrialists interviewed, one of them mentioned a new "internal value to water", in order to make investments in water "profitable"[68]. Though it could be leaning towards the second level, this approach does not reach beyond monetary scales, and does thereby not extend into a protection of the common good.

With the notion of "hydric sufficiency", the 2023 Water Plan announced hopes that relapsed. Transformation does not seem to come into play. The *status quo* is favored and reinforced under this new banner. The transition tradeoffs made in the application of hydric sufficiency further support this argument. I shall expand on them in the following section.

[68] The interviewee mentioned three criteria for assessing the new cost of water: the cost of water consumption (fees), the cost of water treatment (including products and energy used), and the cost of production interruptions.

3.3. Transition tradeoffs? The restrained scope of conservative greening

Green transitions involve a series of tradeoffs in different realms, to which water is no exception (Halsnæs *et al.*, 2024; Muller, 2015). By tradeoffs, I understand the conflicting consequences that arise in the pursuit of environmental goals. They can range across a variety of categories (environmental vs economic goals, environmental vs. social equity, or intra-environmental conflicts) and scales (short-term costs vs. long-term gains, local vs. global). Beyond technical decisions, these tradeoffs are about political arbitrations (Jackson, 2024). As the goal of this section is to study change, I find that the study of the political arbitrations made in the process of the green transitions are indicative of the priorities given, but also of the extent of transformation that can be foreseen.

I argue in this section that arbitrations in water preservation reveal the inertia of hydric transitions in industrial water use. The notion of tradeoff is appropriated to defend a "conservative greening" of industrial water practices. The *status quo* is maintained, if not reinforced as reindustrialization goals further favors these objectives.

The term "conservative greening" is borrowed from Barone (2025). It refers to "the attempt to legitimize public action through ecological ideas or arguments that result in the maintenance of existing institutional arrangements and/or socio-political compromises." It emphasizes the strength of inertia. As I study how the *status quo* is reinforced, I shall pay attention to the construction of lock-ins (self-reinforcing mechanisms that reproduce the *status quo*). Alongside socioeconomic, technological and institutional lock-ins, cognitive lock-ins are also at play (Weituschat et al., 2022). The notion of "conservative greening" is notably tackled by scholars of socio-ecological transitions studies. They show the challenges to exit a growth paradigm that favors further extraction and depoliticization (Feola et al., 2019; Sievers-Glotzbach and Tschersich, 2019, p.6). As discussed with the concept of "hydric sufficiency", a pervasive innovation bias sustains a business-as-usual under a growth-oriented paradigm (Lorek and Fuchs, 2013; Shove, 2018). I find that Barone's concept performs in encapsulating these notions at the same time, while discussing in his article the institutional change and the replaying of power asymmetries. It also has the merit to be anchored in a similar dilemma as the one studied in this thesis: the management of sectoral antagonisms in water policy.

I will discuss these themes in three distinct subsections. I shall begin by introducing the multi-scalar tradeoffs that arise in water governance. I will then move on to discussing how business-as-usual is maintained through the mobilization and construction of tradeoffs. Finally, I will discuss how the local territory materializes the stakes of this conservative greening.

Multi-scalar tradeoffs

Transition tradeoffs happen at multiple scales when it comes to industrial water governance, through similar trends in both Port-Jérôme and the Chemical Valley. I shall expand on them by level, below.

Reindustrialization involves a local–global tradeoff. The relocation of industrial activities in France entails the internalization of industrial externalities that were increasingly borne by countries from the Global South, as a consequence of deindustrialization (La Fabrique de l'Industrie, 2024). It also entails environmental and economic tradeoffs, as the reindustrialization policy might increase pressure on the environment—especially water - while favoring employment and growth (Arambourou *et al*, 2016). In this sense, reindustrialization (with its economic and environmental goals) also conflicts with goals of equity, questioning who will bear the costs of these internalized externalities on the national territory.

At the river basin or watershed level, tradeoffs may occur between different water sources. As large rivers are perceived as abundant, they may be targeted to divert water intakes from smaller river bodies. This appears to be particularly the case for the Rhône River. An interviewee from the National Rhône Company stated:

> "Many regions, as part of their climate change adaptation strategies, are considering stopping withdrawals from certain aquifers or tributaries, and thinking maybe pumping from the Rhône would be a good alternative. [...] Everyone is looking to the Rhône as a solution."

Tradeoffs are also observed at the industrial facility level. There are, of course, economic and environmental tradeoffs, as solutions to implement water preservation are described as too costly by industrialists. Water preservation measures also have intra-environmental implications. Industrialists often point to the difficulty of meeting two expectations simultaneously: decreasing water consumption and decreasing energy consumption. Interviewees mention how the reduction of water withdrawal entails a decrease in the water available to cool installations, which then requires an increase in alternative energies such as electricity. This issue is also observed at the national scale (Couvreur *et al*., 2023, p.56).

Another level of tradeoffs may occur within various dimensions of water. Two examples are regularly mentioned by economic actors and state services: water infiltration must be promoted, but industrial facilities must be on sealed surfaces to limit potential pollution; water saving involves decreased volumes released, which increases the concentration of pollutants in discharges.

Who wins the win-win?

The choices made when it comes to tradeoffs are rarely about objective physical obstacles. As mentioned, they reveal political priorities and arbitrations. As I analyze the tradeoffs justifications, I find that their logic aligns in what was aforementioned: the attempt to sustain a win-win-win fallacy (Anantharaman, 2023). Doing so, their proponents maintain the dream of an eco-modernist narrative (Hajer, 1995), that promises compatibility between ecological goals and economic growth through innovation and governance optimization. I will first introduce how water, among other environmental dimensions, is not favored. I will then discuss the construction of tradeoffs through the notion of "techno-economic limit"[69] by industrialists and their representatives.

If tradeoffs reveal political priority, water use is not the prime concern in industrial green transitions. In France, it is observed that water is preferred over electric systems for industrial cooling purposes (Couvreur *et al.*, 2025, p.56). This is due to the lower cost of water for industrialists compared to energy, but also of a general perception of water as a less critical issue than energy transitions (*ibid*.). In the case of hydrogen production projects at the local level, similar dynamics are observed. An agent of the DREAL Normandie notes:

> "Currently, the narrative is more like, 'yeah, great, there are hydrogen production projects, it's going to bring jobs and it'll be green hydrogen.' Yes, there's a lot of focus on the need for electricity. The water aspect, though, is definitely not being prioritized."

It is clearly stated by this interviewee: water is yet not a core concern when deciding on a local project, at least in Normandie. Water is one factor among others, such as decarbonation and employment. For hydrogen projects, it should be noted that some methods retain a high-water footprint (Henriksen et al., 2023). While the specific proponents of hydrogen are not clearly mapped in this excerpt, one might interpret a broader enthusiasm among state services, local authorities, and economic actors. I also hypothesize that the perceived abundance of water tends to support transition pathways that run at its expense. I also find that this prioritization is unsurprising, if one looks at the foundations of green reindustrialization, under which new industrial projects – notably hydrogen – are driven. Green reindustrialization appears highly carbon-focused, with limited concern for water preservation. It is often introduced as a means to reduce carbon emissions

[69] The techno-economic limit is an argument that consists of the following logic: it is complicated, if not impossible, for industrialists to implement some solutions to enhance water preservation. These solutions are considered either as not existing (techno limit) or too costly to be accessed to (economic limit).

without truly accounting for territorial and physical impacts. One striking example is that within the Green Industry Act, only one measure concerns natural resource management (Legrand and Bourgeaux, 2023, p.23).

The absence of water from the primary concerns also lies in the construction of the impossibility of some "tradeoffs". A primary attempt of industrialists to maintain the win-win can be seen through the techno-economic limit argument. While some solutions exist to reduce industrial water consumption, their implementation is often subordinated to questions of investment cost, return on investment, and competitiveness. Profitability remains the main driver of industrial behavior perceived in this study. Civil society and local authorities often cite this. The "technico-economic limit" is commonly invoked to justify the lack of investment in water-saving technologies, especially in Lyon:

> "Sometimes we reach technical limits [...] the access costs are not economically viable. [...] If we have to invest 5 million to reduce a 10% discharge of... say arsenic, it could jeopardize the company's viability." – an industrialist representative in Lyon

The excerpt of this interview underlines costs (a monetary limit), as a technical one (that could refer to the availability of the resolution. The frequent invocation of the "techno-economic limit" can be misleading, as it assumes that transformations are blocked due to both technical and financial constraints. Yet, regulatory powers and some industrialists widely acknowledge that the real limitation to sufficiency is often not the availability of technical solutions, but their economic viability. A Seine-Normandie Water Agency agent puts:

> "In fact, among the solutions for sufficiency, there isn't really any innovative technique or technology. What we realize is that people just need to take ownership of the issue, put numbers on water usage—and that's very important. [...] After that, the real technical solutions for sufficiency are well-known, already available solutions that have been around for ten years. There may be some small optimizations, but that's not the problem. It's not a technical issue. It's more about the financial aspect, especially the decision of industry leaders to approve investments."

The stakes for industrialists lie in the decisions and financial priorities according to this agent. This is also supported by the industrialist's representative notion of "viability" being jeopardized. Barriers to sufficiency are not primarily technological, they are about the costs, and the viability of these technological solutions for industrialists. This recalls the lowest level of sufficiency discussed above (Schmidhäuser *et al.*, 2024). This

narrative of viability of industrialists also omits the heavy state subsidizing (Davidson, 2019) of water-related innovations[70].

This notion of techno-economic limit is also anchored in the short-term vision of hydric sufficiency.

The costs of water are under-estimated, even though regulation seems to slowly question this paradigm. The rising costs of water are a new indicator that industrialists struggle to account for, as the notion of "techno-economic limit" emphasizes. In Port-Jérôme, an industrialist notes that public regulation remains essential, especially to enforce practices where profitability does not suffice:

> "Indeed, all this equipment is much more expensive, sometimes quite complex to implement. And so, inevitably, regulation, I think, goes in the right direction. It also sometimes pushes industrialists to be more careful and forces us to choose the right solutions for environmental preservation."

The attempt to maintain the *status quo* and the win-win-win paradigm is revealed by the support of technological advances. The same actors who state that "we lack technology" to improve water preservation or also the ones complaining about their costs and hence difficult implementation. This vision is supported at the state level. I observe the following paradox in the report on industrial hydric sufficiency, produced for the Ministry of the Environment:

> "The vast majority of good practices do not mention technological advancements. The mission recommends developing research and innovation on processes that consume less water." (Couvreur *et al.*,2024, 6) [....]
>
> "The mission is convinced that more radical innovations could be achieved once the constraint of water resource availability becomes more stringent." (*ibid*., p.53)

We are thus in the midst of what is termed the "struggle for the eco-modernist promise". Environmental problems—here, water scarcity—are framed as economic opportunities, either through internalizing the cost of environmental damage (e.g., water pricing) or through stimulating innovation that will, in turn, foster growth. This framing is already visible in water governance, as Barone and Mayaux (2019) observe. According to them, this narrative furthers the depoliticization of environmental issues, reducing them to technical, pricing, and managerial questions within a neo-managerial logic. On innovations, Davidson notes how

[70] The water REUT projects are subsidized by the water agencies. Industrial ecology processes are also heavily subsidized by the state services (ADEME, 2024, p.41).

"innovation is far more politically palatable after all, because it does not threaten any vested interests in the current regime. Innovations are also new and exciting; the stuff that wins awards, launches careers and stimulates stock markets." (2019, 2). It keeps the system stuck in an innovation bias (*ibid*.). Behind this notion, I find that there is conservative greening, and the failure to map alternative pathways to efficiency. In that sense, the lock-ins might not be only institutional or sociopolitical or economic, but also cognitive. Studying agri-food transitions for farmers, Weituschat *et al.* (2022) find that "goal frames seem to be dominant in farmers' reported decision-making" and that [...] "goals framed are overwhelmed by the perceived risks and lack of profitability found in the gain frame" (*ibid*., p.2216). Throughout my interviews, apart from the local association in Port-Jérôme, I found a limited number of actors that challenged the growth paradigm model of over-accumulation and resource extraction. Among the actors that called for deep transformations of the industry and denounced its externalities on the environment and health, I could still observe justifications that they did not mean to stop economic development. An interviewee from the Lyon metropolitan area reminds us that "they want to support growth and transformation of local actors". In Port-Jérôme, an interviewee working on wetland preservation states that "[new industrial developments] have to be non-impactful for the environment—for the air, for the water, for the soil. People have to be able to live too, so it's not like... we're not environmental *ayatollahs*.". In these sentences, one could interpret a pragmatism, and a belief that industrial activity may transform to limit the harm caused on the environment. I also interpret these rhetorics as the manifestations of an omnipotent s*tatus quo*, puzzling to challenge. Alternative pathways, such as exnovation (i.e., the phasing out of technologies or practices) (Davidson, 2019) are excluded. Philosopher Alexandre Monin discusses how as a society one can frame renunciation of projects as a political act. His approach discusses how "negative commons" (such as pollution, waste and environmental degradation) can be carefully dismantled to propose an alternative path, keeping distributive justice as the central theme (2023). The definition of needs, its scales and modalities, is a puzzling question, but it appears to not arrive soon.

Ultimately, the eternal attempt to maintain the so-called win-win-win paradigm runs the risk of maladaptation (Barone, 2025). The effects of sufficiency measures and their rebound effects are well documented. This is also visible with tradeoffs guided by the notion of abundance, that allow for transfer of intakes between withdrawing from vulnerable water bodies to large rivers. Such tendencies are already observed in the Rhône:

> "Many regions, as part of their climate change adaptation strategies, are considering stopping withdrawals from certain aquifers or tributaries, and thinking maybe pumping from the Rhône would be a good alternative. [...] Everyone is looking to the Rhône as a solution. At some point, there's going to have to be coordination to make sure everyone doesn't just... Even though the Rhône

> will be prioritized over other tributaries, it will still experience reductions, since a further 20% drop in summer flows is expected — and it has already decreased by 13% at low flow, at Beaucaire, if we look at the confluence, at the mouth."

The attempt to maintain the illusion of abundance extends beyond the industry. The risk is to limit the possibilities for further transition pathways. The territorial scale, despite its materialities, displays the limits and challenges of such an approach.

The territory, materializing the extent and nature of tradeoffs

The territorial scale displays the implications of tradeoffs, beyond economic consideration. It is on the territory that the industry is materially settled, it is as well on the territory that water is impacted. It displays the development of power dynamics within the transitions, its effects, and its priorizations. I will expand here on how conservative greening sidelines justice, while reinforcing power dynamics (Anantharaman, 2023). After discussing the reinforcement of territorial inequality that reindustrialization might include, I will expand on the way civil society is further sidelined.

Green reindustrialization runs the risk of further reinforcing inequalities between and within territories. Even though the relocation of industrial activity (which is not yet fully realized) might have a positive overall impact in terms of green transition[71], it may also reinforce existing inequalities in exposure to industrial externalities (Fressoz, 2011; Bécot and Le Naour, 2023; Chailleux and Smith, 2024). Water again becomes a question of solidarity or distributive justice: how are efforts distributed among different actors in the green reindustrialization process? The internalization of these externalities is acknowledged and accepted to varying degrees by local inhabitants. Contrary to anti-industrial perspectives, the internalization of externalities is, to some extent, endorsed and understood by local actors. A member of a neighboring association, engaged in denouncing PFAS pollution, states:

> "So, our concern — and it's a real concern — is that they might move the company [responsible for PFAS pollution] to a poor country, to a third-world country, to do whatever they want over there without any oversight. We don't want that. We absolutely don't want that. We want the company to stay here — but to make sure that things change."

[71] Reindustrialization retains potential to favor green transitions (i.e., internalization of externalities at a global scale, decrease in emissions due to transports, enhancement of industrial practices, etc.)

Yet, is it fair that it is still the most exposed who bear the costs? In Port-Jérôme, an association representative complains that the industrial projects developed are far from a local concern:

> "[The new polymer recycling project] It's not just a small center doing a bit of recycling — we're talking about thousands of tons of plastic here. And when I say thousands, I actually mean hundreds of thousands of tons. But locally, we don't have that amount of plastic to recycle. So basically, it meant that this was some sort of European prototype. In other words, Port-Jérôme was going to become Europe's trash bin or pollution factory for recycling... So, I don't even need to mention the water, of course."

This evokes the idea that Port-Jérôme—and its local environment, including water—must be sacrificed for broader European recycling goals. Waste becomes "a global resource and profit frontier to be mined" (Anantharaman, 2023, p. 141). This trope of a sacrificed place or river is far from new. The Rhône, as a central object of economic development from the 1960s onwards, was already denounced as a sacrificed river, taken away from its inhabitants (Bouleau and Fernandez, 2012). This notion of sacrifice is further materialized by territorial planning choices. The theme of flooding in Port-Jérôme makes these concerns acute. It may seem like background noise for now, but the question of flood protection could become more pressing. Tradeoffs may arise within the territory itself:

> "We know that we need flood expansion zones. But who's willing to let the levee be removed to recreate those zones? [...] And typically, we might see reactions — sociologically speaking — from certain areas saying, 'So we're going to get flooded to protect Port-Jérôme?' And they're well aware of that, and in a way, they feel it, because maybe they don't have the same kind of economic stakes, even if agriculture is one."

Despite national enthusiasm, the prism of the territory reveals the costs of industrial development. The local level, where natural resource availability becomes material, highlights the limits of a state-led reindustrialization in which calculating carbon emissions is easier than reducing industrial outputs. In Port-Jérôme, the perceived "acceptability" of the industry might mask a silence constructed by constrained choices and the absence of institutional space to discuss the fears (Le Naour, 2024, p.187).

As the green reindustrialization unfolds, the civil society and local actors are further excluded from the consultation arenas. Their role in industrial governance has been continuously decreased by the simplification measures tied to reindustrialization (Le Roux, 2021). In the past years, local associations in both territories mention a decreasing number of files for which public inquiry is required. "The agendas are getting lighter"

as one puts it. This is to be linked with "simplification measures", that include the simplification of consultation procedures, depicted as too heavy on industrial projects installations. Reindustrialization as evidence and a priority (Bouleau et Fernandez, 2012, p.215).

Among all the pathways to sustainability that could be taken, Scoones, *et al.* (2018) explain how it must always be embedded in "plural, democratic politics, with central roles not just for policy, but also for mobilization, critique and political challenge". They find three main themes for that: 1. taking diverse knowledge seriously, with the different worldviews, positions and knowledge it involves; 2. take plural pathways seriously, with the multiple transformations that might be required; 3. take politics seriously, and beyond technical expertise, ensure the representation of a plurality of perspective in fixing changes, focusing on agency. In the field, these preconditions for transformations appear far away. Regarding the first principle, we studied in the first and second chapter how alternative approaches to knowledge, diverse ones are marginalized. Regarding the second condition, the considerations of plural pathways are obscured by power dynamics, as we saw just above with the win-win fallacy supporting a conservative greening. The third principle and the representation of plurality of perspective appears threatened by the simplification of consultation procedure, and the marginalization of transitions within the reindustrialization. This detachment of citizens from public arenas also further favors the stability of the growth-oriented dominant system (Fouilleux and Jobert, 2017). State-led policies and economic development come to reinforce one another in the green reindustrialization, at the expense of the civil society's inclusion. This trope is far from new, and has been observed throughout history in the way the state deals with rivers and water (Swyngedouw 1999, Larrue, 2002).

Conclusion of the chapter

This last chapter has demonstrated that despite talks of transformation, industrial water governance is mostly ruled by continuities. It is at most a beginning hydric transition, but far from a transformation. I do not mean that no change at all is ongoing, especially as the industrial sector is a wide category among which behaviors differ. I find however that the extent of transitions claimed is to be utterly nuanced for the industrial complexes studied. First, I demonstrated that the extent of awareness in two industrial complexes near large rivers, that have so far been exempted from drought measures, is limited. The illusion of abundance comes into play again. I nuance the vision that it is the awareness of water vulnerability that triggered reactions. Instead, it is the state-led reactions that made industrialists realize their vulnerability to increased costs and risks for production. Hydric sufficiency, a widely used concept that vehiculated the idea of a rupture of the

status quo, is depoliticized in favor of business as usual. Far from a radical rethinking of practices, hydric sufficiency comes to legitimize a weak approach to sufficiency, anchored in a crisis-driven and technical approach, away from a reflection on the needs for production. The examination of tradeoffs in the green transitions comes to reinforce the inertia observed. A win-win fallacy is supported to sustain the eco-modernist dream of growth and expansion as resources shrink and degrade. The staging of the "techno-economic" supports the *status quo*. Paradoxically, it posits both the costs of technology as the limit for further improvements, but also demands the developments of new technologies to support the hydric transitions. The support of technology development abides by a logic of conservative greening, through which an innovation bias allows maintaining the existing socio-political compromises while claiming to support ecological transitions. The territorial level, through its materialization of hydro-social relationships, reveals the limits of these compromises, reinforced in the context of reindustrialization. It is looking at the territory that the effects of the green reindustrialization materialize. The notion of sacrificed rivers re-emerges, and power dynamics are reinforced. It is the ones already exposed to industrial externalities that are posed to bear the costs of the national cause. Their vulnerable position is reinforced as reindustrialization is further used to justify the exclusion of the civil society in participatory instances. Looking at water, the green reindustrialization becomes the reassertion of the state's power on the environment, and the river, alongside the industrial actor. While the use of water for reindustrialization could be used as a vector to repoliticize the relationship to the environment, it is constructed to reassert power dynamics.

Conclusion

Water, a common-pool resource at the center of hydro-social interconnections, is governed for industrial uses under constant tension. This tension seeks to balance the potential for economic development while limiting harm to water, treated here as a resource, sink, and occasionally, habitat. As reindustrialization and climate change increasingly pressure the *status quo*, this logic persists. A win-win fallacy is upheld to sustain the eco-modernist dream of growth and expansion, even as water faces mounting strain. This thesis highlights how these dynamics unfold from a territorial and multi-level perspective.

The two case studies are complementary in several respects. These industrial complexes sit at the forefront of green reindustrialization and together present a variety of stakes for industrial water governance. They show both hydrological and social differences, particularly in the games played by actors and the institutions involved.

The three chapters allowed me to draw the following conclusions regarding industries located along large rivers:

First, I analyzed how the foundations of industrial and water governance—specifically the production of knowledge and a shared diagnosis—are already framed by political considerations. Water uncertainties and vulnerabilities are controlled, and power dynamics emerge, providing all the necessary ingredients to frame water in a way that aligns with economic development potential. The cases of Lyon and Port-Jérôme proved complementary in highlighting different components of these governance steps. The PFAS pollution issue in Lyon was particularly relevant for understanding the stakes of data production, especially when it comes to attributing responsibility, thus underscoring its importance beyond routine management. Port-Jérôme, with its extractable volume study, highlighted the specific difficulties of knowledge appropriation within water institutions. By comparing the two local framings, I observed similarities in how water is framed for industrial use. First, water is primarily conceived from a resource-based perspective, which excludes another domain where industrial activity might have a significant impact: wetlands. Second, water is framed as abundant.

Second, I examined how industrial water governance unfolds. In line with existing literature, I found that a neo-corporatist approach sustains the entire industrial water governance system. I highlighted the multi-

level nature of these compromises and demonstrated how they are endorsed through coordination mechanisms by territorial state actors. The cases of drinking water pollution from industrial uses in Port-Jérôme and the Chemical Valley revealed the limitations of the model. Water, as a hydro-social object, materializes these limits. The act of rendering water technical contributes to the exclusion of counter-narratives within institutions. The analysis of policy instruments revealed the differences between the two metropolitan areas. In Port-Jérôme, the metropolitan area adopted a hands-off approach, supporting water provision for industrial development. In the Chemical Valley, the metropolitan area took a more hands-on approach, developing local pricing tools and questioning the triple-win model to which the industrial sector complied.

Third, I examined the extent of change in industrial water use following the 2022 drought. I found that, despite some evolution, the techno-efficient solutions adopted still support a weak sustainability approach. Civil society, meanwhile, has been further pushed out of consultation spaces. The hydric transitions appear to reinforce the state's role and the neo-corporatist system. Civil society is excluded from consultation arenas, at the same time as the green reindustrialization discourse could call for a repoliticization of resource use in industry. The green transition pathway followed by reindustrialization does not seem to align with a just transition.

These findings lead to several contributions, both theoretical and empirical, which I will now detail.

One contribution is the finding that larger French rivers are framed, across all categories of actors, as abundant water bodies that are relatively less vulnerable to climate change and anthropogenic use compared to other water bodies. Throughout the thesis, I showed how this framing of abundance shapes and reinforces current water management practices. Abundance justifies water intakes, dilution possibilities, and resource sharing potential. It also contributes to inertia in changing industrial practices.

Another contribution is empirical. I addressed a gap in the French social sciences landscape, as no study I was aware of specifically targeted industrial water governance. This allowed me to deepen our understanding of how the challenges specific to industrial and water governance reinforce one another (e.g., data availability, participation, power dynamics).

Additionally, in describing the governance of industrial water use, I provided evidence of changes in industrial water use in the specific context of reindustrialization and green transitions. I also offered a sociological analysis of the effects of the 2022 drought in France—an area that had not yet been studied. The conclusion that state action drives change, complementing the idea that resource vulnerability triggers

awareness, warrants further study in other fields. The guiding concept of this shift—"hydric sufficiency"—also had not been studied previously. The territorial perspective I employed further opened the debate on distributive justice in the use of natural resources in ecological transitions, an issue often sidelined in carbon-focused green transitions.

Several themes touched upon in this thesis could be explored in future research. First, the dual nature of water—as both a resource and a pollutant emitter—has been hinted at throughout the thesis. This warrants further investigation, particularly into and across different categories of water use. Second, the pervasive notion of river abundance and its influence on water policy-making also requires deeper exploration. This is especially important because representations of water influence how it can be governed. In that regard, the absence of non-humans in the framing of industrial water governance is telling.

Water, at the interface of various interconnections, is an object that carries strong political potential. It is both a cause of conflict and a source of connection among individuals and between them and their environment. Green reindustrialization also carries a political project, one that could call for the repoliticization of water and natural resource use on the national level. While the relocation of industries within the national territory appears necessary, it cannot be decoupled from a reflection on the actual needs of production and consumption. If abundance ever existed, it surely does not any longer. As we stand at a pivotal transitional moment, attention must be given to the decisions being made and their implications not only for the environment but also for justice. Now is the time to reorient pathways to change and avoid maladaptation to ensure a just transition beyond carbon emissions.

Annex 1 : Glossary

Artificialization	Process by which natural or agricultural land is transformed into built-up areas, resulting in the loss of natural habitats and soil sealing
Audit Eau	Instrument developed at the regional level by the DREAL Normandie. It aims to foster a decrease in industrial water use.
Caux Seine Agglo	Metropolitan area in which Port-Jérôme is located.
CODERST	Departmental council for the environment and health and technological risk. In this administrative commission, a range of stakeholders issues an opinion on draft prefectural orders, notably on industrial installation and extension.
Commerce River	River that flows through the Port-Jérôme industrial complex.
Compensation	Legal obligation to ecologically compensate for the consequences of land artificialization.
Decentralized state services	Decentralized state services in France are regional or departmental branches of the central government that implement national policies, operating with some administrative autonomy.
DREAL	Regional decentralized state service agency responsible for implementing environmental, urban planning, and housing policies. In this master thesis, this generic term refers specifically to a service in charge of industrial policy implementation.
Drought decree	Official government order that declares a water shortage situation. It can establish specific restrictions and measures to manage water use in that context.
Estuary	Coastal area where freshwater from rivers and streams meets and mixes with saltwater from the sea.
Effluent	Wastewater discharged by industrial facilities.
GIP Seine Aval	Scientific organization working on the ecological state of the Seine Estuary.
Grand Lyon	Metropolitan area in which the Chemical Valley is located.

Local monitoring commissions	Local monitoring committee organized at the scale of a group of industrial facilities. It gathers public authorities, industrial operators, environmental NGOs, employee representatives, and residents to monitor the environmental impact and safety of classified industrial sites, promote transparency, and facilitate dialogue between stakeholders.
PFAS	Group of human-made chemicals used in industrial processes. They are characterized by their environmental persistence and their effects on human health.
PSH	Instrument developed at the regional level by the DREAL Auvergne-Rhône-Alpes. It aims to foster a decrease in industrial water use.
REUSE	Process of treating and recycling wastewater or used water from industrial operations. The goal is to use it again, within the same facility or for other purposes.
River basin	In this master thesis, it refers to the largest hydrographic unit around river. There are six in France, including the Seine-Normandie river basin and the Rhône-Méditerranée river basin.
SAGE	Water planification document at the scale of the watershed.
SDAGE	Water planification document at the scale of the river basin.
Seveso facility	Industrial facility classified under the European Union's Seveso Directive. It is considered to present risk for the environment, due to the storage or use hazardous substances above certain thresholds.
Water abstraction	Water withdrawal refers to the total amount of water taken from a source (such as a river, lake, or aquifer).
Water agency	Institution at the river basin scale in France. They are in charge of implementing the water policy.
Water consumption	Water consumption, on the other hand, refers to the portion of the withdrawn water that is not returned to its source, typically because it has evaporated, been incorporated into products, or been lost to the immediate water cycle.
Water intake	Water intake refers to the total amount of water taken from a source (such as a river, lake, or aquifer).
Water Plan	Action plan introduced by President Macron in March 2023. Following the 2022 drought in France, it introduced measures to relieve pressures on water in France. The aim is to reduce water withdrawals by 10% by 2030 across all sectors (domestic, agricultural, and industrial).

Watershed	In this master thesis, it refers to the smaller hydrographic units that compose the river basin (e.g. the Commerce watershed).
Wetland	Semi-aquatic ecosystem, covered partly or fully with water, that supports ecological functions (e.g. biodiversity, flood regulation, natural filtration of pollutions, etc.).

Annex 2 : The tables of actors interviewed

The following table summarizes the actors met by each case[72] :

	Corresponding to ...	Port-Jérôme	Chemical Valley
Decentralized State Services	DREAL (for industries)	1 interview, regional unit (2 interviewees)	2 interview - 1, regional unit - 1, departmental unit (2 interviewees, including one DREAL inspector)
	ARS (regional health agency)	1 interview, departmental unit	/
	DDT (departemental service)	1 interview (2 interviewees)	1 interview
Hydric scale governance	River basin (water agencies)	1 interview	2 interviews - 1, intervention department - 1, planification department
	Watershed (SAGE facilitator)	1 interview	/
Local government	Metropolitan area	4 interviews, including : - 2, water department - 1, economic development department (2 interviewees) - 1, risk department	3 interviews - 1 with the water department -2 with the economic department
	City	/	1 interview, City of Lyon environmental health department
	Other relevant public local actors	1 interview with the Winding River Seine Regional Park (2 interviewees)	/
Scientific actors	French Geological Survey (BRGM)	1 interview (2 interviewees)	1 interview
	Other	1 interview with the GIP Seine Aval	1 interview with the Eco-citizen Institute
Industrial Actors	Industries	2 interviews	1 interview
	Other Economic actors	1 with HAROPA port	1 interview with the National Rhone Company (2 interviewees)
	Actors related to the industries	1 interview, a person in charge of the SOCRATE study	4 interviews -1, regional Chamber of Commerce and Industry -1, regional chemical industry federation - 1, regional association of industries - 1, regional competitive cluster
Civil society	Local association	2 interviewees (both neighborhood defense and environmental defense)	2 interviews - 1, residents' defense association - 1, environmental association
Total of interviews		18	19
Total of persons interviewed		23	21

[72] Some actors classified in this table could be into several categories (e.g. the SAGE facilitator in Port-Jérôme is also hired an employee of the metropolitan area).

Annex 3: Complementary elements of contextualization

This annex introduces complementary elements of contextualization to the ones provided in the introduction. It comprises four parts. A diagram of French water governance (1), a diagram of French industrial water governance (2), a detailed case introduction of the Chemical Valley (3), a detailed case introduction of Port-Jérôme (4).

1. Water Governance in France

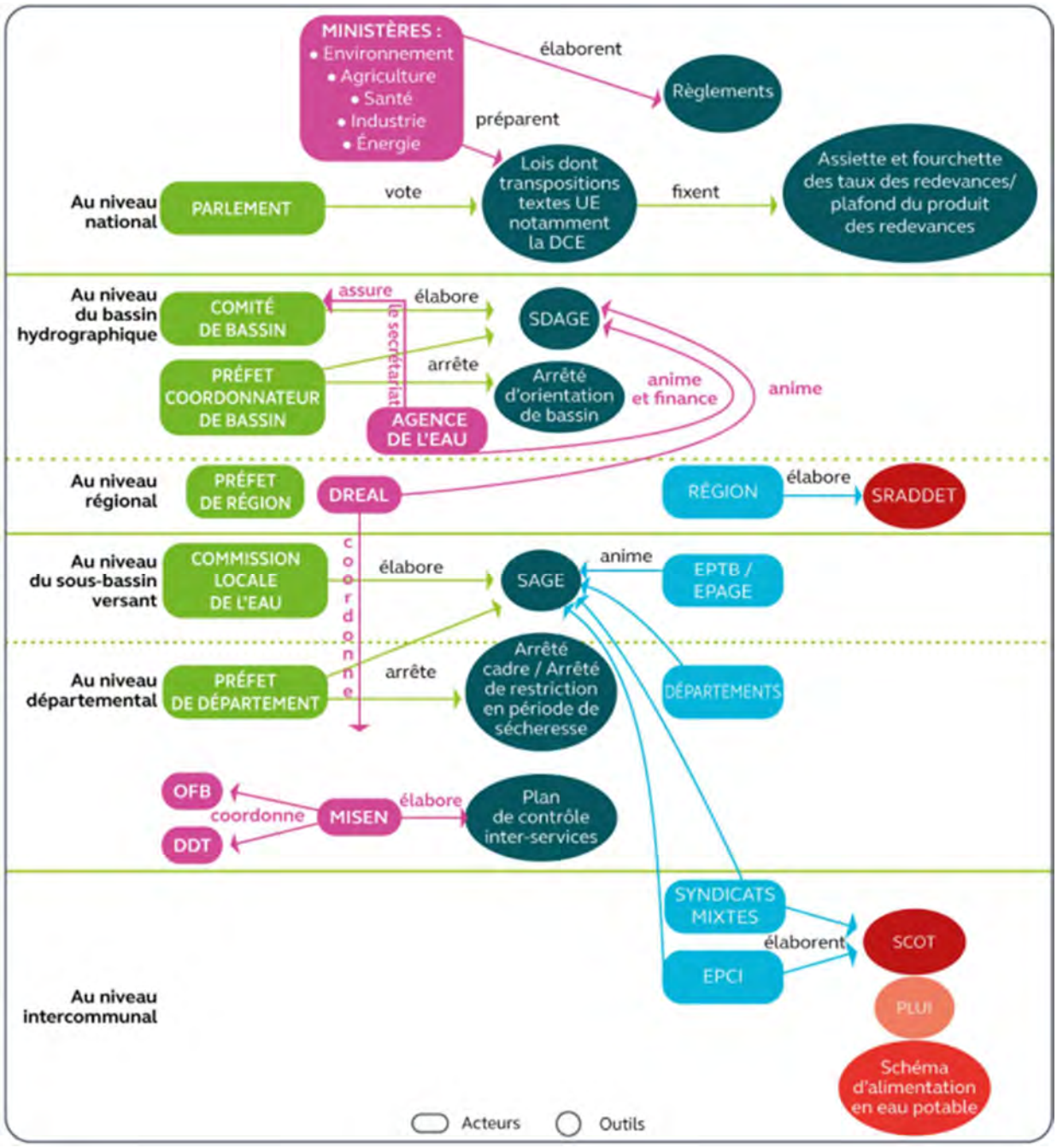

Figure 1. Water governance in France. Source: Cour des Comptes (2023)

2. Industrial Water Governance in France

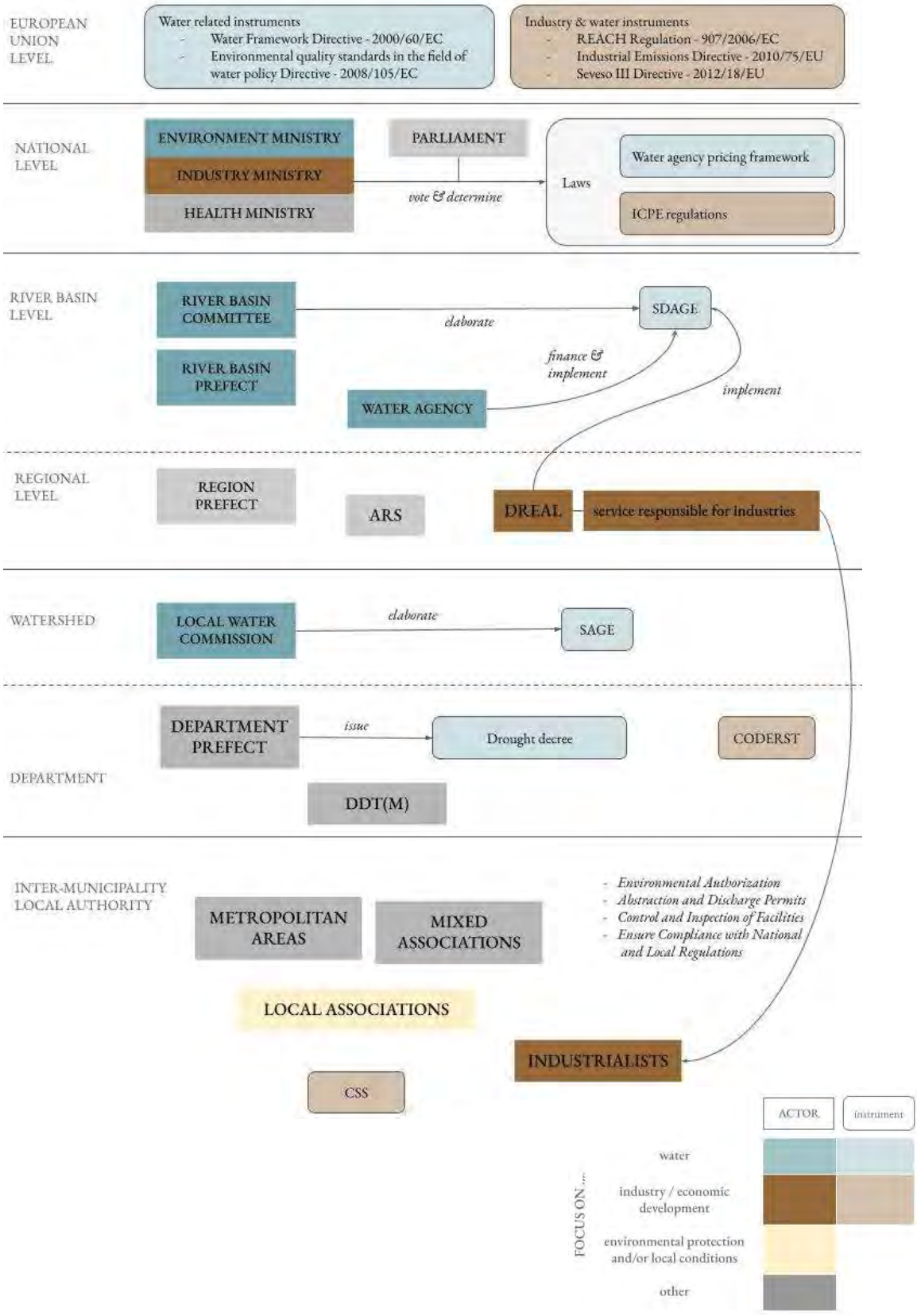

Figure 2. Diagram of Industrial water governance. Source : author (2025)

3. The Chemical Valley, Auvergne-Rhône-Alpes, France

The Chemical Valley is an industrial site located south of Lyon, in the Auvergne-Rhône-Alpes region of France. Its activity centers on the "chemical-energy-environment" nexus. Situated along the Rhône River, it draws and discharges most of its water there. While the perception of an abundant Rhône reduces concerns about quantitative scarcity, a major pollution scandal—the PFAS case—has become a central issue in industrial water governance. This section will delve deeper into these characteristics and examine the governance of water in the area.

Territorial and Socio-Historical Context

Historically connected to the chemical and petrochemical industry, the Chemical Valley has taken a turn towards sustainability in the past decade. This green reindustrialization governance displays a case of public private partnerships.

The foundation of the chemical valley dates back to 1853, as the Perret brothers - industrialists from Lyon - settled in Saint-Fons downstream from Lyon (Métropole du Grand Lyon, 2023, p.6). From then, the industrial development soared, the banks urbanized, population grew (*ibid*.). The hydroelectric plant installation in Pierre-Bénite by the National Rhône Company further developed the area, known as the "chemistry cradle" *(ibid.).* The current chemical valley stretches from Lyon to Givors, downstream from the Rhône and Saône confluence. On 1 100 hectares, it covers 14 cities (including 9 in the Lyon metropolitan area), corresponding to 100 000 inhabitants (80 000 in the metropolitan area) (AMARIS, 2020). The economic activity employs 50 000 people, including 10 200 in the chemical, energy and environment branch (*ibid*). It comprises 10 high threshold Seveso sites (*ibid*.).

Located in the Auvergne-Rhône-Alpes region, the Chemical Valley belongs to the region with the most production and export of chemical products in France (Plateforme IET, 2025). Despite prosperous times, the deindustrialization waves have hit the chemical site in the 2000s (Arab and Crague, 2023). Bouncing back in a context of degraded image and production, the chemistry sector took a turn towards the "chemical-energy-environment sector" from the 2010s onwards (ibid.). Activities pertaining to this branch have been developing, alongside the traditional chemical and petrochemical activity. It is exemplified with projects such as Terenvie (soil depollution and circular economy), Lyon Rhône Solaire (renewable energy) or Symbio (hydrogen) (Métropole du Grand Lyon, 2021, p.6). Through these developments, Chemical Valley is anchored in the larger green reindustrialization ambitions. This is further exemplified by the DECLyC project : "*DECarboner LYon vallée de la Chimie*" (Decarbonizing the Chemical Valley). Laureate of the ZIBAC call

for project, this project aims at reducing by 80% the carbon emissions of the site by 2050. It targets various themes, such as hydrogen, renewable energy, carbon capture, or reductions in water consumption. It has a 1,9 million euros budget, the half is financed by the French State (Lyon Vallée de la chimie, 2024)

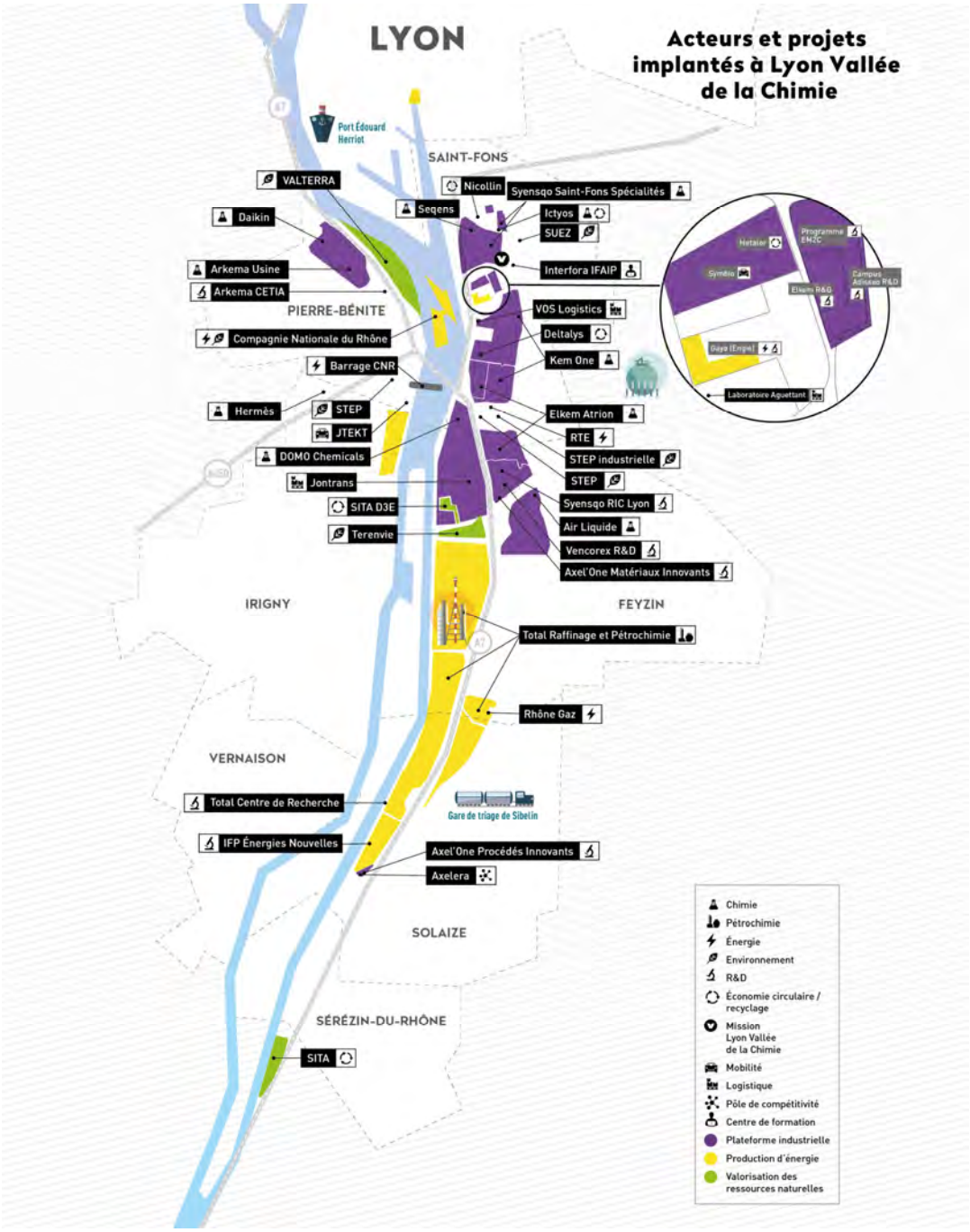

Figure 3. Map of the Chemical Valley. Source : Lyon Vallée de la Chimie, (n.d.)

The governance of this green reindustrialization has been relying on a deepened co-development between local public and private actors (Arab and Crague, 2023). Through a hybrid model, various actors have come together to co-develop a territorial project : The Chemical Valley, and especially since 2013 its "Territorial Mission" (a particular dedicated department) to oversee the project; the municipalities; the state

services, and notably the DREAL in the context of the risk prevention plan; the regional council, and industrial actors (*Ibid*.). Since 2020, the green majority at the head of the metropolis has participated in this process. A notion of a "sufficient industry" is developed. In 2025, the reindustrialization dynamic in Lyon is described as limited, as the chemical sector faces fierce international competition.

Industry and the waterscape

The Chemical Valley is predominantly supplied by the Rhône River. While the river's large flow poses few short-term concerns, the industrial water debate mainly centers on qualitative aspects, particularly around the issue of PFAS.

The Chemical Valley's existence relies on the presence of the Rhône River. Taking its source in the Furka Glacier in Switzerland, the Rhône flows down until the Mediterranean Sea. It is the French river with the largest waterflow. From 1839 onwards, the Rhône was artificialized to ensure the navigability and favor the production of hydroelectricity (SMIRIL*, n.d*.). Its riverbed, that could be between 1 to 3 km wide, was narrowed down (Parisot, 2013). Its secondary channels, the "lônes", were dried (*ibid.*). The installation of the Chemical Valley on the riverbeds of the Rhône participated in this artificialization. Today, the tendency of the chemical valley relies more on land use intensification than extension, limiting artificialization risks.

On the long run, industrial activities in the Chemical Valley might face a provisioning question. So far, the site was preserved from the effects of the drought, thanks to its location on the Rhône. It contrasts with neighboring industrial sites (notably on the east of Lyon). Yet, as a 2014 study pointed out, the abundant flows of the Rhône are threatened by climate change (Agence de l'eau Rhône Méditerranée Corse, 2014). It is the French River that is the most impacted by Climate Change. By 2055, periods of low waterflow will worsen and become more regular (Agence de l'eau Rhône Méditerranée Corse, 2023). Downstream, the waterflows that are already shrinking could reach a 20%d decrease (*ibid.*) By the end of the century, the melting of glacier will deprive the Rhône from a major alimentation source (*ibid.*).

Looking at water quality in the river basin, notable improvements can be noted : between 2013 and 2019, the micro pollution followed by regulations have decreased by 60% (Eau France, 2018, p.48). Yet, historical pollutions are still present, and pressures can still be exerted. The Rhône-Méditerannée SDAGE reports the Chemical Valley as one of the industrial areas that creates pressures on groundwaters (2022, 115). Since it has come to public attention in 2022, the per- and polyfluoroalkyl pollution (PFAS) in the Chemical Valley crystalizes the question of industrial pollution. PFAS are a class of over 4,000 synthetic chemical compounds. These substances have been used since the 1950s in industrial processes (e.g., firefighting foams,

surface treatment chemicals, electrical wire insulators, etc.) and consumer products (e.g., non-stick coatings, textiles and carpets, food packaging, non-stick kitchenware, etc.). Until now, were not listed in the regulated substances. PFAS are characterized by their high bioaccumulation in living organisms and their strong persistence in the environment. Traces of substances banned for several decades can still be found, which is why they are often referred to as "forever chemicals." (ARS Rhône-Alpes, 2025). The scientific literature is still far from providing a comprehensive overview of the effects of pollution, but some impacts have already been proven on human health (e.g., carcinogenic effects, reduced birth weight, decreased immune response to vaccination) as well as on wildlife and plant life (*ibid*.). Even though PFAS come from various sources, two industrial actors are called out for their heavy use in their industrial processes : Arkema and Daikin. Downstream from Lyon, the Ternay withdrawal site presents particular high concentrations of PFAS. For years, the population of four cities alimented by this site - Givors, Grigny, Solaize et Marcy l'Etoile – has been drinking contaminated water. The extent of pollution is still in the process of being assessed, especially as the PFAS contamination might happen through water, air and soil.

Governing industrial water uses

The governance of industrial water use in the Chemical Valley follows the classic French system, with two notable particularities. First, the transnational nature of the river gives its governance a specific character. Second, municipal authorities are particularly involved. In addition, various actors have emerged in response to the PFAS pollution.

The transnational character of the Rhône makes its management particular. There is no dedicated organ of coordination between France and Switzerland. The governance relies on a system of self-coordination, between private and public operators, on both sides of the border (Pflieger and Bréthaut, 2015, 33). In the context of climate change, it raises the question of the ability of this system to adapt to climate change, and the rivalry that could emerge on water use, especially as the Rhône waterflows decrease (*Ibid., p.*36). Following a study on the governance, reflections on the future of this governance are still engaged at the moment. Indirectly, the water in the Chemical valley directly depends on this management.

At the level of the chemical valley, the governance of industrial water use is organized in the traditional way, between the ICPE regulation and the Water agency. The Chemical Valley depends on the Auvergne-Rhône-Alpes decentralized states services at the regional level, and the Rhône at the department level.

Regarding water governance, it is in the scope of the Rhone-Méditerrannée-Corse Water agency.[73] There is neither a SAGE or covering the Chemical Valley, nor any contract or territorialized water governance instrument covering the chemical valley.

The lowest administrative grade that covers the hydric scale of the chemical valley is the Grand Lyon metropolitan area. They administrative scale has limited competency on the side of industrial water management. The Economic department may favor best practices in their call for projects for the Chemical Valley. For instance, in 2024, CIRCULYZ – a metropolitan call for project for industrial land development – focused only on polymer recycling and bio-based chemistry but also on environmental decontamination (water, air, and soil).The Water department may interact with a small share of industrial actors from the Chemical Valley connected to their drinking water and have a sewage network. Linked to their competency on water distribution, the Grand Lyon may act in the context of pollution of their networks, through a pricing policy and

In the context of water governance, some other structures can be called to participate. The "*Le Syndicat Mixte du Rhône des Iles et des Lônes (SMIRIL)"* (The Joint Association for the Management of the Rhône, Its Islands and Side Channels) is a local public institution working on the preservation of the Rhône river, particularly in the Lyon Metropolitan Area. The Geological and Mining Research Institute (BRGM) can bring its expertise upon demand to decentralized state services, the water agency, or local governments. Associations such as France Nature Environnement can also be contracted by municipalities for their expertise on a given environmental topic, notably water. They can also conduct activities with economic and industrial actors. In the context of the P-FAS pollution, local scientific and health actors could be convoked (i.e. cancerology Lyon Berrard Center). The municipality also requested the expertise of the "*Institut Ecocitoyen pour la Connaissance des Pollutions*" (*Ecocitizen Institute for Pollution Awareness and Research)* to participate in the production of studies on PFAS pollution.

At the level of the industrial site, different actors can be mentioned. Industrialists themselves of course, engaging with the regulation and with their internal process. There are also various regional industrial associations that represent them in institutional instances, notably in the River Bassin Committee, as well as federations such as France Chimie. There are also 7 R&D centers, as well as three notable key actors : Axelerea a regional competitivity cluster), Axel'one (a mutualization plateform), and the association for the Chemical Valley Sustainable Development (AMARIS, 2020). The regional Chamber of Commerce may also have a part in supporting water relates innovations, or in representing industries in some institutional instances. There is

[73] The names Rhône-Méditerannée and Rhône-Méditerranée-Corse will be sued interchangeably for the Water Agency.

no existing mutualization system on water for the Chemical Valley. Yet, in the context of the DECLYC study, coordination by the Chemical Valley Mission and Axelera, there is a dedicated batch on water in which 6 industrialists participate.

The civil society also participates in industrial water governance through different instances. They are represented in water governance institutions. There takes part in the several the local site monitoring committee (CSS) that cover the chemical valley, as well as in the Departmental council for the environment and health and technological risks (CODERST). They can also be directly called to participate in public concertation by industrial actors. In the context of PFAS pollution, inhabitants and environmental association mobilized, and filled charges against industrialists.

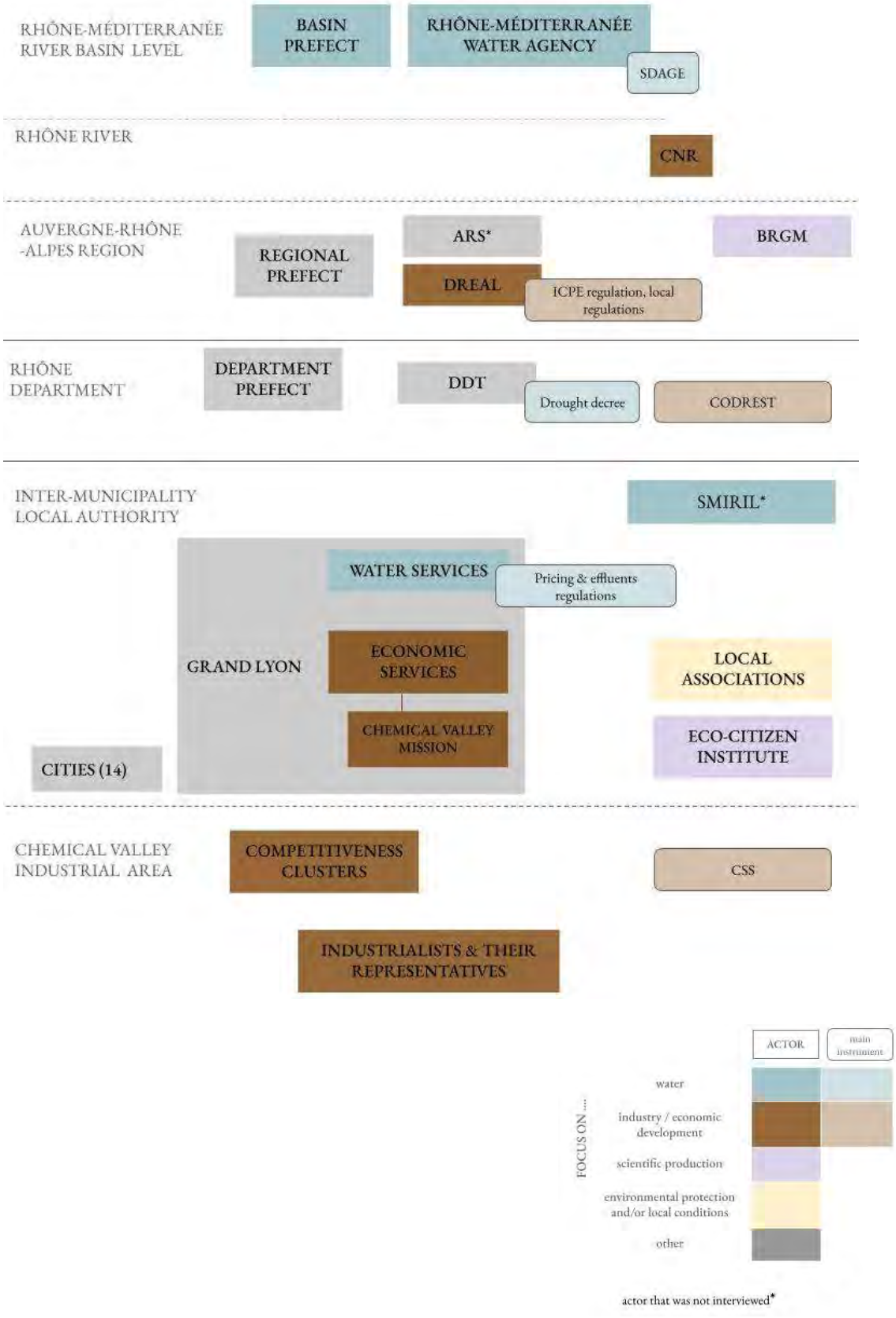

Figure 4. Water governance of industrial uses, main actors, Chemical Valley. Source: author (2025)

4. The case of Port-Jérôme, Seine-Maritime, France

Port-Jérôme is an industrial site located on the Seine estuary, in Normandy, France. Its activity is mainly centered on the petrochemical industry. The site is known for its circularity processes—particularly its industrial water plant—and for the relatively low level of conflict surrounding industrial presence and development. Water-related issues primarily concern salinization, flooding, and wetland preservation. The site is also at the heart of a dynamic reindustrialization process. This section will delve deeper into these characteristics and examine the governance of water.

Territorial and Socio-Historical Context

Port-Jérôme illustrates a case of strong local synergies centered around one main industry. Although its activities have diversified, industrial operations remain a major employer and provider in the area. The region is positioned at the heart of green reindustrialization, as highlighted by several ongoing projects. It is marked by the presence of an industrial association and strong synergies between the city and the surrounding area.

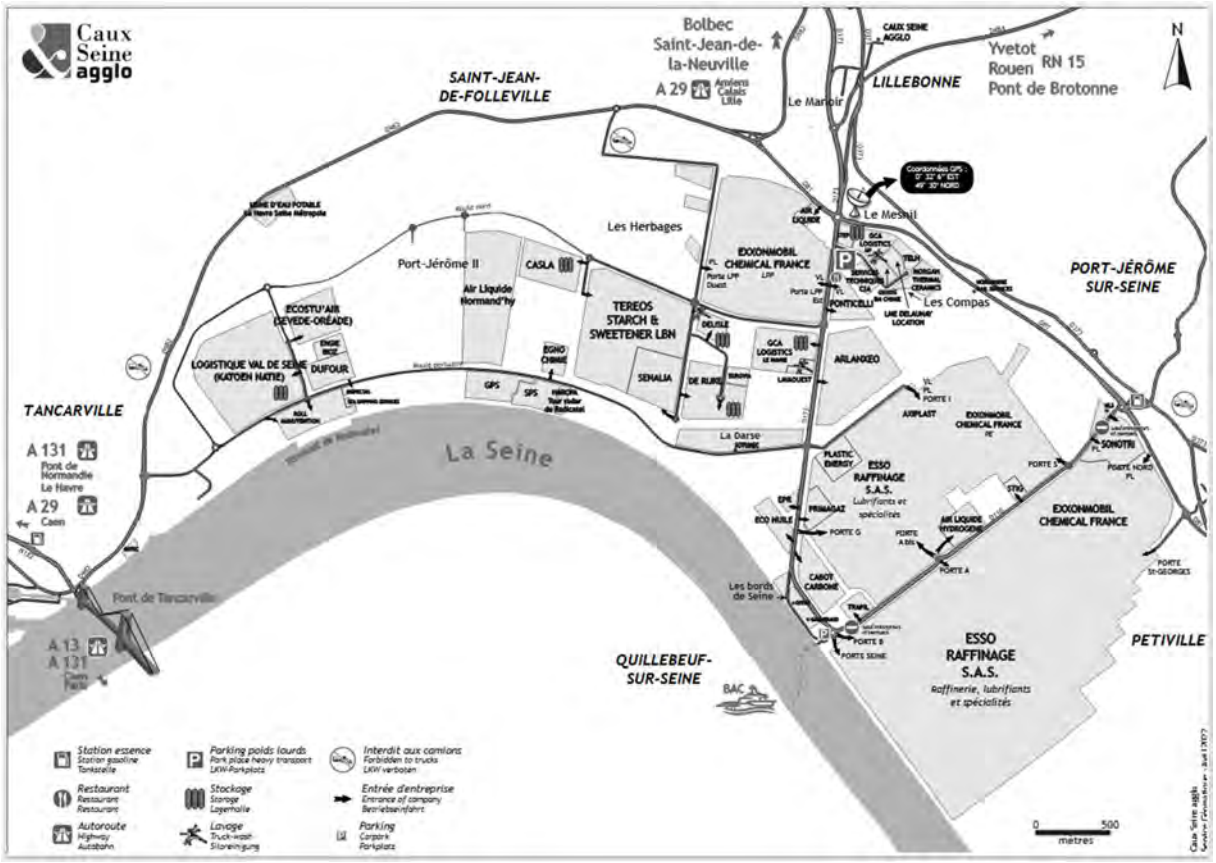

Figure 5. Map of Port-Jérôme. Source : Caux Seine Agglo (2022)

Port-Jérôme is located on the last loop of the Seine, between Rouen and Le Havre, two major industrial cities in France. In the late 19th century, the industrial area was limited to the textile industry, around Notre-Dame-

de-Gravanchon, a small city. In 1933, Esso and Mobil, two American oil companies, set their sights on Notre-Dame-de-Gravenchon to develop their business (Lemaistre, 2024). From that moment, the area's extension soared around petrochemical activity : demographic development, construction of amenities for workers (*ibid*.).

Port-Jérôme is a dynamic industrial area, at the core of the green reindustrialization. The industrial landscape encompasses the historic petrochemical activity, in petroleum refining, chemicals, petrochemicals, solvents and alcohol (AMARIS, 2019). This activity is at the origin of risks : 14 sites are classified as Seveso, comprising 9 "high threshold" sites (Caux Seine agglo, *n.d*.). In the past decades, the industrial zone has coupled traditional activities with an orientation towards circularity. It is often introduced as a pioneer in industrial ecology processes. The examples range from the industrial water plant in 1972, an early study for France in 2009 on industrial symbiosis, the development of synergies among industries in energy recovery (CNR, 2019). In 2021, the Normandie Region labeled the industrial area as "Parc d'activités Normandie Responsable" (Normandy Responsible Business Park). New projects oriented towards circularity or the ecological transitions develop, such as Eastman (waste recycling), Air Liquide (hydrogen projects) or Futero (bioplastic production and recycling). Port-Jérôme also benefits from a larger regional industrial dynamism, surrounded by major industrial area such as Rouen and Le Havre. The certification of this area in the two phases of the "Territoires d'Industries" program (*Industrial Territories)*[74] exemplifies it. Industrial green transition is also operated at this scale. In 2023, Port-Jérôme belonged to the laureates of the ADEME[75]call for projects on industrial transitions, ZiBAC[76]. INCASE, industrial association, engaged with the two others to form the SOCRATE association.[77] The goal is to work on the decarbonation of the Seine Axis, on topics such as energy efficiency and conservation, new energies, industrial ecology, carbon capture and storage, as well as acceptability and employment (Haropa, 2023). It has a budget of 15 million euros, half of which is financed by the State (*ibid*.).

The industrial area cohabits with several cities and its inhabitants. The site lies on a continuum of 1 430 hectares (AMARIS, 2019). In 2016, the four cities covered which lies the industrial site - Notre-Dame-de-Gravenchon, Auberville-la-Campagne, Touffreville-la-Cable and Triquerville - merge and take Port-

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[74] *Territoires d'Industries* is an industrial program launched in 2018 to support reindustrialization. It is constituted of two phases : Phase I (2018 à 2022) and Phase II (2023 – 2027). The selected territories received financial support.

[75] ADEME stands for "*Agence de l'Environnement et de la Maîtrise de l'Energie*" translating as the agency for the enviroment and energy. This public agency is in charge of supporting and financing ecological transitions projects.

[76] ZiBAC - " *Zone Industrielle Bas Carbone*" - means Low Carbon Industrial Zone.

[77] The two other associations are from Le Havre (Synerzip) and Rouen (UpSide). SOCRATE means "*Synergie pour une Organisation Collective et raisonnée sur l'axe Seine de la Transition Énergétique*" (Synergy for a sustainable collective organization on the Seine axis of the Energy Transition).

Jérôme-sur-Seine as a name. In its current shape, the site thus covers now 4 cities : Port-Jérôme-sur-Seine, Lillebonne, and Saint-Jean-de Folleville, as well as Petitville in lesser proportions. Those four municipalities belong to the metropolitan area Caux Seine Agglo. The latter gathers 50 cities (80 000 inhabitants). Since 2020, Virginie Carolo-Lutrot, Port-Jérôme-sur-Seine's mayor, has become president of the agglomeration. The metropolitan area and the industry collaborate on industrial development, especially through the economic development services. Caux Seine Agglo also takes the role of facilitator for the local industrial association, INCASE. It is the only municipality ensuring such function in France. Gathering around 60 members (Incase-Normandy, *n.d.*)., was founded in 1972. INCASE works on risk management, security and the environment, as well as economic development and the circular economy (Observatoire des Territoires d'Industrie, 2024, 10).

Port-Jérôme is known for a certain "acceptability" of the industry, with limited conflicts and oppositions to industrial projects (Observatoire des Territoires d'Industrie, 2024). A large share of local inhabitants is linked to the industry through their employment or their closed ones, and though the spillovers from the industry. With a network of units and connected subcontractors, Port-Jérôme welcomes 200 businesses, representing 6 000 jobs - including 3 000 directly linked to production activities (AMARIS, 2019). The founding actors, now merged together in ExxonMobil, is still a major local player, of which the activity is connected to various subcontractors. The announcement of the closing of their unit came as a shock, threatening hundreds of local employments (Derouet, 2024).

Industry and the waterscape

Port-Jérôme was built through land reclamation, on the floodplain of the Seine. Industrial activity represents a major source of pressure on the river, the effects of which are still being assessed. While the area has been relatively spared from droughts, the overexploitation of aquifers and the risk of flooding remain central concerns.

The development of the industrial area has always been connected to water use. The installation of Esso and Mobil relied on the presence of the Seine. Industrial activities rely on water withdrawal from the Seine and its groundwater to support their activity. use and discharge and dilute the effluents of their productions in the Commerce River and in the Seine. The Seine also allows for navigation, hence circulation of goods.

The industrial area is also not settled on any land : it has been constructed on wetlands, in the Seine floodplain through processes of dewatering and backfilling. Despite intense artificialization processes, there

are remaining wetlands within and at the borders of the industrial are (SAFEGE, 2015, p.42). Wetlands have important functions for the environment : hydraulic regulation, especially for flood risk; they act as natural filter, retaining pollutions: they are biodiversity reservoirs (*ibid.,).* Wetland are threatened by anthropic pressures (*ibid*.,), either through urbanization but also through industrialization processes. The question of wetland preservation is put in balance with industrial development projects in Port-Jérôme.

In Port-Jérôme, industrial actors rely on three main sources : the water of the Seine, its groundwater, and the Commerce River. A limited share of water is on drinking water alimented by the metropolitan networks. On industrial water provision, Port-Jérôme displays a major specificity : the industrial water plant of Norville. In the 1960s, the Seine groundwater was put under pressure. The refineries development had led to an increase in water demand, that resulted in "a significant drop in the level of boreholes and a marked increase in water salinity in areas closest to the Seine", leading to a near "exhaustion" of local water resources (Catoire and Lecornu, 1972). Salt water cannot be purposed without treatment for industrial uses, notably since it is unsuitable for certain production, and that sodium chloride is highly corrosive for infrastructure. To address this, it was recommended shifting towards surface water sources (*ibid)*. The Norville waterplant is born from this situation, in 1969. This infrastructure relieved pressure on the aquifers by pooling industrial water withdrawals from surface water in the Seine. Since then, through a 32km network of pipes, Norville has been supplying water to the Port-Jérôme but also the Havre industrial Area. In 2016, the repartition of water uses was the following : 39% for the Havre Industrial Ara, 51% for Exxon Mobil, and 10% for 24 other subscribers to the Port-Jérôme industrial area. (Caux Seine Agglo, 2023). In 2023, as the water plant was wearing out, a renovation was conducted. The potential for water production was increased, from 7500 m^3/h to 10 000 m^3/h (Agence de l'eau Seine-Normandie, 2023). Despite the water plant, the salinization still threatens the area. On the one hand, the effects of climate change cause the upward shift of the salinity gradient on the estuarian area (Berne, 2023, p.111)[78]. It risks salinization the water abstraction of the industrial water plant. On the other hand, overexploitation might lead also to the salinization of groundwaters. An "*Etude*

[78] The upward shift of the salinity gradient refers to the move upward of the freshwater/saltwater boundary. It may be due to different factors (reduced freshwater inflow, rising sea levels, or increased groundwater extraction). The upward shift of the salinity gradient can result in the intrusion of saltwater into areas that were previously freshwater, impacting ecosystems and water quality. This is a particular issue for industrialists, since salt water cannot be used for their industrial processes without treatment.

Volumes Prélevables" (Extractable Volume Study) is currently conducted to assess the risks of overexploitation.

So far, Port-Jérôme's industrial activity has been relatively preserved from the effects of droughts. Even though several events have been noted in the past decade, it never went as far as the production suspension[79]. The factors will be expanded upon in chapter 1 and 2. Nonetheless, the territory is still subject to the effects of climate change on the river, such as decrease in rainfall, increase in temperature, decrease of the average waterflow on the river basin from 10 to 30%, or sharp drop in aquifer recharge (Berne, 2023, p.111). Qualitative stakes, rise in effluents concentration, increased salinization, are to be expected.

The quality of the Seine water has been primarily degraded by historical activity on the river, including the industry. Despite improvements, the effects of the past industrial pollutions can still be traced back in the river (Fisson, 2017, 2023), impacting the rivers' biodiversity. Chronic hydrocarbon pollution from some industrial is still observe on the site (Grollier , 2025). The Commerce river faces high pressures on its quality (SAFEGE, 2015, 31). When it comes to drinking water, the main threats to quality do not come from industrial uses in Port-Jérôme, but rather from agricultural pollution. Yet, 2012 was an exception. ORIL, an industrial site upstream from the Commerce River caused the pollution of a metropolitan drinking water intake point (BRGM, 2020). The metropolitan area had to distribute the population plastic bottles for more than a year (Banzet, 2012). The intake point is not back to service in 2025. Even though the area is not settled on Port-Jérôme industrial zones, it is now connected administratively through a site monitoring committee (CSS).

The water question in Port-Jérôme is also posed through the flooding theme, either through runoffs or by the river overflow (SAFEGE, 2015, p.51). Climate change further increases the risk of Seine flooding (Berne, 2023, p.111), to which the industries – located in the floodplain – are particularly vulnerable.

Governing industrial water uses

The governance of industrial water use in Port-Jérôme follows the typical patterns of industrial water management. What sets it apart is the strong involvement of the metropolitan area in supporting industrial development. It also features a distinct configuration of local actor dynamics.

[79] Production suspension can be demanded in the drought decree by the departmental prefect, depending on the severity of the drought and the water body in which the water abstraction happens.

The water governance of industrial uses in Port-Jérôme is organized through the usual system for that type of users. Industrialists depend on the Normandie regional service (for the DREAL, the DDT and the ARS), and on the Seine-Normandie Water agency, Corresponding to its river basin. Some local tools may be noted.

The metropolitan area – Caux Seine Agglo – plays a pivotal role both in industrial development and water management. In terms of water governance, the agglomeration oversees a local planning instrument, the SAGE Commerce, which includes the Port-Jérôme area. When a SAGE is set up, a facilitator is appointed to ensure its implementation. In the case of Port-Jérôme, the facilitator is hired by Caux Seine Development. It is upon the request of the local water commission that the aforementioned Extractable Volume Study was commanded. The agglomeration also intervenes in the industrial water management, as it owns the Norville industrial water plant. It is handled by the metropolitan water management department. Economic development services may also grapple with water use. Upon the examination of filed for potential industrialists' installation, the economic development department (*Caux Seine Developpement*) examines the file with the assistance of the Water department regarding water uses. They also work on compensation for industry-related artificialization, which often impacts wetlands. This department oversees the development of synergies among industrialists in the industrial area.

The metropolitan area might be in contact with various actors in the context of industrial water governance. The "Parc naturel régional des Boucles de la Seine Normande" (*Seine Loops Regional Natural Park in Normandy*). They have five missions defined in the French Environmental Code : protection of the natural and cultural patrimony, local planification, social and economic development, education and information, experimentation.(Fédération des Parcs naturels régionaux, n.d.). Even though the territory of Port-Jérôme does not belong to the perimeter of their charter, they entertain relationships with Caux Seine Agglo. At the Estuarian Level, the "Groupement d'Intérêt Public (GIP) Seine Aval" (Public Interest Group for the Downstream Seine) plays a part of scientific mediation. They conduct research on the Seine estuary and connect with their members who are developers, to which Caux Seine Agglo belongs. The "Syndicat mixte de gestion de la Seine Normande" (*Mixed Union for the Management of the Seine Normande*) – is an institution that works at the scale of the Seine River to unify flood protection strategies among agglomerations. The "Bureau de Recherches Gologiques et Minières (BRGM)" (*Geological and Mining Research Institute*) is a scientific public institution to which the expertise can be resorted to by the metropolitan area in specific cases. The BRGM conducted a study on the 2012 pollution (David *et al.*, 2020). They are also in charge of the extractable volume study commanded by the Local Water Commission (Idée *et al.* 2020).

At the level of the industrial area, some aspects of water governance may unfold. The aforementioned SOCRATE project – carried by three industrial associations - involves a study diagnosing industrial water use and potential for synergies on the area of Port-Jérôme, Rouen and Le Havre. At the scale of the industrial unit, industrialists participate in the governance of the resource : they are in direct contact with the DREAL inspection. They also have water management goals, pushed by their internal policy. Other economic actors play an important role. HAROPA port is a public institution. It is born from the merging of three ports on the Seine : Le Havre, Paris and Rouen. It has a role of economic development, and participates in the reindustrialization and its decarbonation goals. It interacts with the water question on different aspects, notably by handling cases of pollution emerging from port activity, but also through the industrial development process, that may involve wetland artificialization and compensation.

In the area of Port-Jérôme, there is a limited development of civil society movements that connect to environmental impacts of the industry. Three main associations can be noted. Associations can take part in several instances that relate to industry and water use. They can be represented in water governance institutions : the Local Water Commission (sub-water shed level) and in the River Bassin Committee (river basin level). Several times a year, they take part in the local site monitoring committee (CSS) and the Departmental council for the environment and health and technological risks (CoDERST).

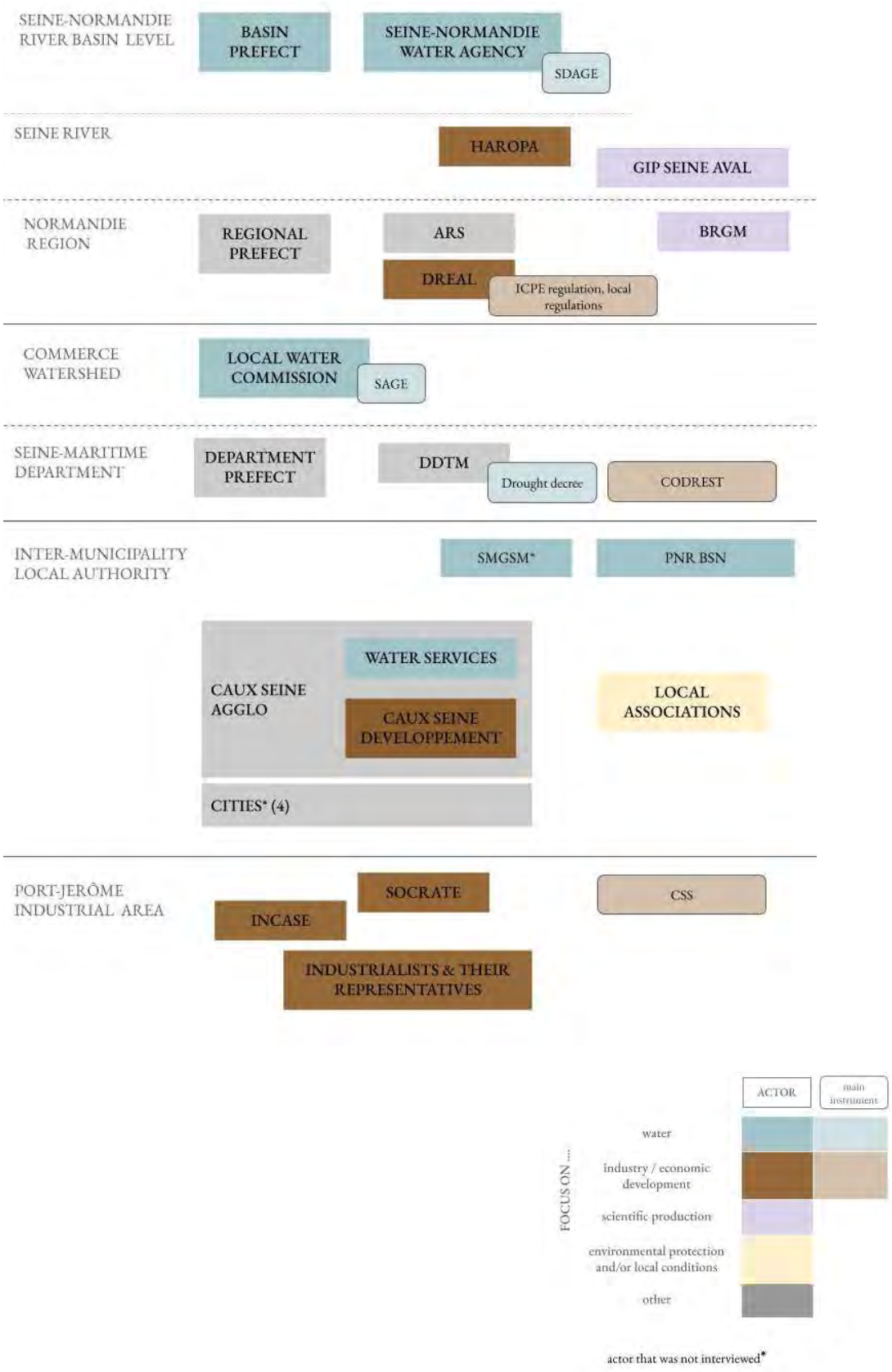

Figure 6. Water governance of industrial uses, main actors, Port-Jérôme. Source: author (2025)

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