

SUBSTITUTING CONVENTIONAL RAW WATER WITH REUSE WATER. LIMITATIONS AND CONSTRAINTS. ILLUSTRATION USING THE MONTPELLIER MÉDITERRANÉE MÉTROPOLE PROJECT

REMPLACEMENT DE L'EAU BRUTE CONVENTIONNELLE PAR DE L'EAU RÉUTILISÉE. LIMITES ET CONTRAINTES. ILLUSTRATION A PARTIR DU PROJET DE MONTPELLIER MEDITERRANEE METROPOLE

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ABSTRACT

Wastewater reuse from treatment plants has been put on the political agenda, perceived in France as a solution to current and future water shortages. It is particularly promoted in coastal areas, where treated wastewater is discharged into the sea. This is the case for MAERA, the main wastewater treatment plant in the Montpellier metropolitan area, which discharges 30 million m³ of water into the sea each year. This plant has two advantages: a fresh water not contaminated by salt and the proximity of a conventional untreated water distribution network ('RHR', from the Rhône River) that could be used to distribute REUSE water. Replacing this conventional untreated water makes even more sense as it faces high demand and has other potential uses.

This article outlines the outcomes of investigations conducted by Régie des Eaux de Montpellier in collaboration with BRL Exploitation and DV2E. The project was conceived with a multi-purpose objective, enabling a network connected to the station to serve several types of usage (urban, agricultural, industrial). This analysis highlighted the numerous limitations and constraints of such a solution: water with limited potential; water less acceptable than conventional untreated water (as it is less universally usable and more constrained) and very expensive, with a complex financial structure; and, finally, water whose governance framework remains to be established. Given these difficulties, the necessary and sufficient conditions are not currently in place to enable its widespread development close to users at an affordable cost.

Keywords: Coastal REUSE; technical constraints; governance; cost-sharing; impact on untreated water users.

RÉSUMÉ

La réutilisation des eaux usées issues des stations d'épuration figure désormais à l'ordre du jour politique ; elle est perçue en France comme une solution aux pénuries d'eau actuelles et futures. Elle est particulièrement encouragée dans les zones côtières, où les eaux usées traitées sont rejetées en mer. C'est le cas de la MAERA, la principale station d'épuration de l'agglomération montpelliéraine, qui rejette chaque année 30 millions de m³ d'eau en mer. Cette station présente deux avantages : une eau douce non contaminée par le sel et la proximité d'un réseau de distribution d'eau non traitée conventionnelle (« RHR », provenant du Rhône) qui pourrait être utilisé pour distribuer l'eau de réutilisation. Le remplacement de cette eau non traitée conventionnelle est d'autant plus pertinent qu'elle fait l'objet d'une forte demande et qu'elle a d'autres utilisations potentielles. Cet article présente les résultats des études menées par la Régie des Eaux de Montpellier en collaboration avec BRL Exploitation et DV2E. Le projet a été conçu avec un objectif polyvalent, permettant à un réseau raccordé à la station de répondre à plusieurs types d'utilisations (urbaines, agricoles, industrielles). Cette analyse

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a mis en évidence les nombreuses limites et contraintes d'une telle solution : une eau au potentiel limité ; une eau moins acceptable que l'eau non traitée conventionnelle (car moins polyvalente et soumise à davantage de contraintes) et très coûteuse, avec une structure financière complexe ; et, enfin, une eau dont le cadre de gouvernance reste à établir. Compte tenu de ces difficultés, les conditions nécessaires et suffisantes ne sont actuellement pas réunies pour permettre son développement à grande échelle à proximité des utilisateurs à un coût abordable.

Mots-clés : réutilisation côtière ; contraintes techniques ; gouvernance ; partage des coûts ; impact sur les utilisateurs d'eau non traitée.

Introduction

Treated wastewater reuse (REUSE) from sewage treatment plants has been placed on the political agenda in France, particularly since President Emmanuel Macron's speech on 30 March 2023, which led to the Water Plan. It sets out two key objectives: "a 10% reduction in water abstraction by 2030" and "widespread adoption of non-conventional water sources" (including REUSE) by 2027. REUSE is thus seen as a solution to current and future water shortages. It is particularly promoted in coastal areas, especially where treated wastewater is discharged into the sea, thereby having no impact on the condition of watercourses.

MAERA, the main wastewater treatment plant in the Montpellier metropolitan area, appears particularly well suited to the development of a REUSE system: it discharges 30 million m³ of water into the sea each year; it produces fresh water uncontaminated by salt; it is located near a untreated water distribution network ('RHR', from the Rhône River) that could be used to supply REUSE water to users, thereby helping to reduce investment costs. Replacing this conventional untreated water (supplied by the Bas-Rhône-Languedoc company – BRL) would be all the more appropriate given that the latter is subject to high demand and could be usefully deployed elsewhere in the Mediterranean region. Finally, the current modernisation of MAERA has included the installation of a REUSE treatment plant, which is expected to produce 150 m³/h of REUSE water from 2028 at European Class B water standards.

This article presents the results of a study (50% funded by the Rhône-Méditerranée-Corse Water Agency) carried out in 2024 and 2025 by the Montpellier Méditerranée Métropole (3M) public Water Authority in collaboration with BRL Exploitation and a consultancy firm (DV2E) as part of its 'Pitot Plan' for the REUSE development by 2030³. The project was designed with a multi-use objective, enabling a grid network from the station to serve several types of use (urban, agricultural, industrial). This article is divided in two parts: the first one presents the case and the methods utilised to perform the study, the second on the results.

Material and Methods

The study focused on water uses within a 4 km perimeter of the MAERA wastewater treatment plant. Five areas were identified (

Figure 1): the area in blue to the south-west of the city of Montpellier, comprising two sub-areas: A1, supplied by the Rhône water network (RHR), and A, supplied solely by drinking water and comprising mainly industrial uses (including the Ametyst anaerobic digestion plant, a tram depot and two concrete manufacturers); zone B (in green), located to the east of the municipality of Lattes, comprises the only agricultural area within the study area not supplied by untreated water from the Rhône, with two agricultural estates and two sports complexes equipped with irrigated stadiums; Zone C (in red) comprises all the green spaces of the municipality of Lattes; Zone D (in yellow) combines agricultural and urban uses; finally, Zone E (in purple) is highly urbanised, with untreated water from the Rhône mainly used by households, for watering the municipality's green spaces and for firefighting. A stakeholder consultation on the potential uses of REUSE water across the entire metropolitan area

³ The reports on which this article is based are as follows: Perrot and Bellanger (2025), Sirven and Vernay (2026) and Régie des Eaux de Montpellier Méditerranée Métropole (2026).

(including MAERA): a questionnaire was sent in June 2024 to 39 elected representatives, 58 local, metropolitan and water authority officials, as well as to members of the water authority's management board and 8 associations and experts, to obtain a range of views on the potential use of REUSE water and its possible and appropriate applications. Forty-three people responded (including 12 elected representatives and 20 officials).



Figure 1. Identification of potential sites for REUSE around the MAERA wastewater treatment plant
The study mainly relied on three sources to estimate the potential demand for water:

This consultation was supplemented by a series of three workshops held on 10 September 2024, 6 November 2024 and 28 May 2025, bringing together members of the water authority's management board, local elected representatives, and stakeholders from the institutional and research sectors. These workshops enabled participants to explore the issues in detail, first by outlining the REUSE framework in France and in the Hérault department, and then by reviewing the current regulatory landscape to ensure all attendees were equally informed. During the second workshop, participants also shared details of REUSE studies and projects currently being explored within the metropolitan area, as well as those underway in other French local authorities. During the first two workshops, small-group sessions were organised to explore the potential benefits of REUSE in the territory and identify which uses should be prioritised and which should be treated as non-priority. The workshop also discussed the pricing approach to be adopted, as well as the governance arrangements, if such a solution was adopted;

Customer files from the 3M Water Authority (drinking water supply) and BRL, the operator of the RHR (untreated water supply). These files made it possible to distinguish between 'private' uses (i.e. industry, agriculture or households) and 'public' uses (watering of local authority green spaces, fire hydrants, etc.); A face-to-face survey carried out in the area to identify the current water usage patterns of 'private' customers connected to the RHR water supply or who are potential users of REUSE water (drinking water subscribers whose needs could be met by untreated water, and new applicants for water). Twenty-three users of the RHR water network were surveyed out of the 75 'private' users identified.

Results and Discussion

This study highlights the fact that the potential for reusing treated wastewater using the RHR network is limited, that it is less acceptable than conventional untreated water, that it is costly, and that it requires specific governance arrangements, which are often overlooked.

A limited potential

There are several reasons why this water has limited potential, following the various possible uses currently using the RHR or potentially connectable to the network debated during the initial consultation phases (the survey and workshops 1 and 2) between June and November 2024.

A wide variety of agricultural uses, some of which do not exist (no current irrigation)

Agricultural uses are highly varied and often seasonal. In the areas surrounding the MAERA station, RHR water is used to supply market gardening, arboriculture, field crops, livestock farms and plant nurseries. Irrigation is carried out using drip irrigation on certain plots (particularly for arboriculture, nurseries or protected vegetable growing), but also by sprinkler irrigation (arable farming, open-field vegetable growing). Certain uses cannot be met with Grade B water, thereby reducing the potential for REUSE water accordingly. Moreover substitution is one of the necessary conditions for obtaining subsidised funding to invest in the REUSE project. The overall aim is to move towards greater water efficiency by developing agricultural practices more respectful of an increasingly limited resource. Developing irrigation for crops currently not irrigated (such as vineyards, which are widespread in the area) using reclaimed water therefore appears challenging.

Declining water requirements for green spaces

The watering of public green spaces may also be an issue. It accounts for a significant proportion of local authorities' water consumption, but this proportion is falling as a result of efforts to reduce required water volumes by favouring less water-intensive plant species. In the city of Montpellier, for example, the proportion of water used for irrigation fell from 40% of drinking water consumption in 2022 to 33% in 2024, representing a 33% drop in consumption over three years. In 2024, for the city of Montpellier, this represents 185,000 m³ of drinking water and 15,000 m³ of RHR water. Watering green spaces, if not carried out using the RHR water network, is done using the same system as street cleaning, meaning water is taken from various points across the area.

Industrial uses with case-by-case quality requirements

Industrial uses are fairly limited in the region due to its focus on the third sector. But they do exist, particularly around MAERA, as mentioned earlier. Each industrial use requires a water quality specific to the type of process involved, which necessitates a case-by-case analysis. Nevertheless, these are very interesting uses, as they often involve large volumes, with a regular demand throughout the year that effectively substitutes for drinking water. However, this represents limited quantities (for example, in Zone A, it is estimated at 63,000 m³ per year, given that these uses are often spread across the area).

Other uses considered non-priority

The consultation process has finally identified the following REUSE uses as non-priority: private green spaces (golf courses), communal gardens and/or private gardens, green walls, and groundwater recharge.

Water less acceptable than conventional untreated water

The issue of acceptability is often discussed in terms of a reluctance to use REUSE water (Garin et al., 2021; Nancarrow et al., 2009; Rice et al., 2016). However, the level of acceptability can be explained by other factors, particularly usage constraints: this water is in fact less universal in its use than conventional untreated water and is more restrictive.

Less universal water

Conventional untreated water (such as RHR water) is suitable for multiple uses and subject to relatively few restrictions due to its presumed relative safety (only the filling of swimming pools is prohibited). In contrast, REUSE is regulated by a set of standards that specify its permitted uses based on the quality

of the water produced. The relevant legislation includes: [Decree No. 2023-835 of 29 August 2023](#) and the [Ministerial Order of 28 July 2022](#), supplemented by the following usage orders: [the order of 14 December 2023 on the watering of green spaces](#) and the [order of 18 December 2023 on the irrigation of crops](#). Consequently, certain uses are prohibited: watering livestock and watering family gardens. Others require water of excellent quality, to meet 'drinking water' standards for bacteriological parameters (A+ or A), such as street cleaning or firefighting. Converting a conventional water supply network into a distribution system for reclaimed water (REUSE) means that certain uses no longer permitted under the REUSE scheme – even though they were permitted with conventional water – can no longer be supplied. This explains why many operational REUSE projects prioritise single-use and single-quality applications.

More restrictive water

The use of this water is subject to stricter regulations in France, given that the legislation aims for zero risk, even though some of the recent texts have introduced more flexible rules. Similar restrictions apply to other uses of Class B water, again in line with the principle of barriers: respect for irrigation timetables for public green spaces, and drip irrigation for most irrigated areas (whether private or public). The significant number of REUSE water quality checks required by regulations are also very burdensome, as they are far more stringent than those required for conventional untreated water (and therefore also have an impact on cost, a topic addressed later). All the constraints outlined above have enabled the identification of four priority areas for the implementation of REUSE: areas A-A1, B-C, D1 and D2. Areas D3 and E are in fact supplied with RHR water, primarily to meet domestic and firefighting needs, uses not compatible with the chosen quality level B (see Figure 2).

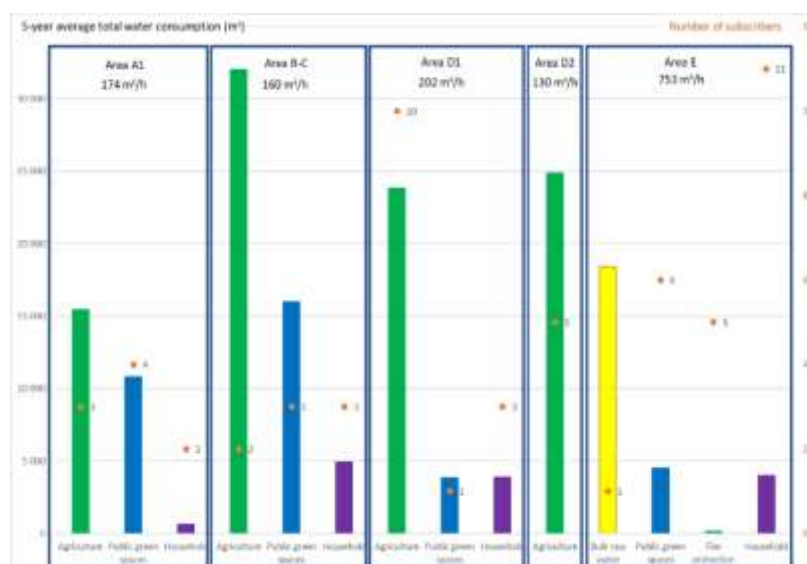


Figure 2. Average volume of RHR water billed in BRL (2020–2024) across the potential sites and the number of customers by type of usage

Very expensive water

Supplying REUSE water, in the studied case, requires connecting the (future) MAERA REUSE chain to the RHR branches, providing for water pressurisation (as the treatment plant is at a low point), reinforcing or replacing some parts of the RHR water distribution network, or even extending this network to supply water for new uses currently served by drinking water. All these investment costs have been estimated for various connection scenarios. They are presented in

Figure 3 in relation to the volumes potentially available based on two consumption assumptions (the average observed between 2020 and 2024 and that observed in 2024)⁴, as water consumption varies significantly depending on the year under consideration (Figure 4).



Figure 3. Estimate of annual water costs and their breakdown based on estimated consumption volumes (first column: average for 2020–2024; second column: consumption in 2024) – Water quality: Grade B

The investment cost is divided into two parts: the portion eligible for subsidies (in orange) and the portion not eligible (in purple). Added to this investment cost, amortised over the projected actual lifespan of the facilities, the expected operating cost (in green) (mainly supplementary analyses and energy) is included. These estimates do not take into account other costs: the cost of preparatory studies (including permits), of upgrading or replacing networks (except for scenario A1), of taking over the RHR antennas that would be dedicated to the REUSE and the potential cost of increasing the capacity of the REUSE system (currently designed for a maximum flow rate of 150 m³/h) if one does not rely on the reduction coefficient or water turns organisation. Similarly, water consumption is very often seasonal, leading to periods of varying lengths during which the distribution systems lie unused, and the operating costs associated with water quality issues requiring management upon restarting have not been taken into account here either.

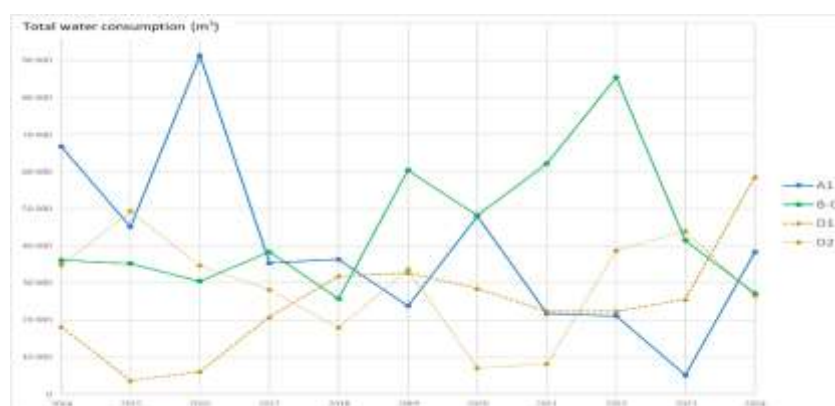


Figure 4. Total volume of RHR water billed by BRL in areas with potential for water reuse (2014-2024)
In the case study, high capital and operating costs, low demand in terms of volume and limited financial support (22%) mean that the cost of reclaimed water is, at best (A1 – high consumption), comparable to – or even significantly higher than – that of drinking water.

⁴ It is assumed here that all consumption levels observed over these years will remain unchanged. However, as previously outlined, these assumptions may prove to be incorrect: some agricultural uses may not be met, and some agricultural users may no longer subscribe to the service. Furthermore, local authorities tend to reduce their consumption. The figures considered may therefore be significantly overestimated.

Water with a complex financing structure

These costs must be compared with the prices currently paid by the subscribers concerned. Table 1 shows the average price paid by a customer, depending on their contract (agricultural water – EA or water for other uses – EUD), for the observed consumption (average over the 5-year period or the year 2024). This average price varies depending on the contract (EUD is subject to a higher tariff than EA) and the reference consumption. For the distribution network operator, however, fluctuations in revenue are well amortised by the weight of the fixed component (billed according to subscribed flow rates), which represents on average more than 80% of the water bill when consumption is low, and at least 38% for EUD contracts and 54% for EA contracts when consumption is high.

Table 1. Average price of RHR water by area based on consumption assumptions

Area	Use	Average cons. 2020-2024	Cons. 2024
A1	Agriculture	0.56 €/m ³	0.32 €/m ³
	Public green spaces	1.38 €/m ³	5.13 €/m ³
	Total	0.90 €/m ³	0.51 €/m ³
B/C	Agriculture	0.29 €/m ³	0.46 €/m ³
	Public green spaces	1.22 €/m ³	1.81 €/m ³
	Total	0.60 €/m ³	0.88 €/m ³
D1	Agriculture	0.70 €/m ³	0.39 €/m ³
	Public green spaces	1.33 €/m ³	1.40 €/m ³
	Total	0.79 €/m ³	0.45 €/m ³
D2	Agriculture	0.57 €/m ³	0.54 €/m ³
A1+D1	Total	0.84 €/m ³	0.48 €/m ³
A1+D1+D2	Total	0.76 €/m ³	0.49 €/m ³
A1+B/C+D1+D2	Total	0.70 €/m ³	0.55 €/m ³

When comparing the prices paid (Table 1) with the projected costs (Figure 3), it becomes clear how difficult it would be to recover the costs (even taking into account subsidies) from subscribers. The implication is that other sources of funding would need to be identified, such as contributions from drinking water and sanitation budget, or from local authorities' general budgets relating to agricultural policies or green spaces; in other words, either from subscribers to water and sanitation service or from the town's population not directly benefiting from the REUSE service.

This is a practice found in many other French cases (Montginoul et al., 2024), particularly regarding the investment component, even if this is not publicly disclosed. However, even if full coverage of the investment costs was envisaged, the operating costs could never be covered by estimated revenue levels. This is an important point to keep in mind: the case of Eastern Australia during the 2000s drought should serve as a warning. At that time, numerous desalination and REUSE facilities were built without taking into account the cost they represented for society, a decision that was strongly criticised afterwards (John C. Radcliffe, 2015; Radcliffe and Page, 2020), leading to calls for more ex ante economic analysis (Listowski et al., 2003; Marsden Jacob Associates, 2013).

There is an additional complication to this financial reality: of the eight farmers surveyed who recognised the benefits of REUSE water, five did so because they believe REUSE water will cost them less than conventional untreated water (see the issue of acceptability).

Water whose governance is often overlooked

Finally, the governance of REUSE water supply system is often overlooked and merits greater attention. In addition to cost-sharing, there is the question of how to manage the system: whilst the project owner and wastewater manager may be responsible for the treatment plant and the supply of REUSE water via payment terminals at the station site, supplying REUSE water as close as possible to where it is needed raises the question: which project owner, which operator, is responsible for water distribution,

particularly if water turns need to be implemented (cf. the current design capacity of 150 m³/h)? Similarly, the traditional role of a water distributor in a monopoly situation must be reconsidered here: it has indeed been observed in other cases (Montginoul et al., 2024).

That water service subscribers do not commit to the long term and do not hesitate to cancel their participation when they consider the terms to be too unfavourable, which could jeopardise the fragile financial balance envisaged. A commitment for a sufficiently long period should be included in the water supply contract, even before the network is set up.

Conclusion

This analysis, based on a case that was deemed highly favourable to REUSE, highlighted the numerous limitations and constraints that must be taken into account before considering such a solution: the potential uses are restricted, thereby reducing the potential and thus the acceptability of REUSE water; REUSE water is significantly more expensive than conventional water; the financial arrangements are therefore more complex to put in place; finally, the governance of REUSE supply system is often overlooked and deserves greater attention.

The MAERA area is therefore far from meeting the necessary and sufficient conditions to allow for massive expansion of the potential volume at an affordable cost: the volumes currently eligible for a substitution, at a very high cost, are estimated at between 26,000 and 170,000 m³/year, which is far below the initially estimated potential (3 million m³).

Replacing one resource with another that generates greater constraints and additional costs is prohibitive. Only areas facing severe water stress could consider this. However, such stress must be structural rather than cyclical; otherwise, it would undermine the economic viability of this solution when weather conditions are more favourable, as has been observed in Australia (J. C. Radcliffe, 2015; Radcliffe and Page, 2020).

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