Directed by
Grégory Quenet

PIONEERS

SINCE 1853

Veolia: Forging a Path through
Environmental History

VEOLIA

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Veolia: Forging a Path through Environmental History

Foreword

by Antoine Frérot

Chairman of the Board of Directors of Veolia

As the saying goes, "You can't really know where you are going until you know where you have been." This is just as true for a company as for an individual. Celebrating an anniversary provides a special opportunity to take a brief look back at the past in order to dive into the future.

This is what Estelle Brachlianoff invites us to do in celebrating Veolia's 170 years. At the same time, her reflections on the company's history inspire us to keep finding solutions to the challenges that have emerged at every step in the development of modern society.

As you will discover from the start and throughout these pages, the DNA of Veolia, the "sacred fire" that compels the men and women of this company decade after decade, is the drive to leave their mark in their field.

For my part, I believe that from the very beginning of our history, our ambition has always been to be useful, to contribute to public health, to fight against pollution, to establish prosperous societies, and to advance human progress. But our path was drawn uniquely, through successive touches, almost as if by an Impressionist painter—sketching a commitment to ecological transformation before the concept was even fully defined. In this way, our history reveals itself as a call to perseverance and humility, but also to the pride of participating in a collective endeavour that surpasses the contributions of each individual.

I hope that future generations, like those before us and the members of the Veolia team today, will experience a fulfilling and enriching journey as they continue down this path, and that they will remain dedicated to serving our entire international community ●

Preface

Estelle Brachlianoff

Head of Veolia

"I invite you to delve into this fascinating 170-year journey."

In 1853, the first major Parisian department store had just opened its doors. The cinema would not exist for a long time yet. It was the time of the first railways, the year when, after a vote of its statutes and the obtaining of its first contract, a decree signed by the hand of the French Emperor Napoleon III would authorize, on December 14, the creation of the Compagnie Générale des Eaux.

The Compagnie Générale des Eaux, born in the heart of the First Industrial Revolution, would become, year after year, decade after decade, one of the essential components of what we know today as Veolia.

Founded to bring water to the fields as well as to the cities, from the beginning it satisfied unmet needs, much like a startup today. It gained its footing as part of environmental history, establishing a connection between humans and natural resources. Driven by a pioneering spirit, the company would help to write that history thereafter.

The book you are holding in your hands recounts that history.

The story is woven over time by ten generations of dedicated women and men, true teams of entrepreneurs. They have tested and developed new solutions based on the learning of their predecessors, spreading their impact through growth. They are pioneers who imagine new solutions, bring to the world what did not exist before and create value where no one else can see it. Their solutions are drawn line by line, from the observation of new needs and often in times of crisis: from the cholera epidemics of the nineteenth century to the intensification of droughts today, passing through resistant typhus epidemics, quarry pollution, or geopolitical tensions around energy. Innovation does not happen without trial and error, with both sometimes necessary to open up new paths. Often, behind a failure, a new development can be hiding.

In uncovering these developments, different professions have been invented or found within the company. Starting with **water** networks, Veolia initiated its activities in pipelines and water treatment. Naturally associated with urban sanitation, it then created, acquired, and developed companies for **waste** collection, treatment, and sorting. It also integrated entities specialized in the production and supply of **energy**, serving local authorities as well as industries. Thus, from the mid-twentieth century, it structured a range of solutions for different regions, capable

of addressing their challenges in regard to well-being, health, and prosperity. These professions intersect, nurture each other, and intertwine, such as the fight against water pollution leading us, during the post-War period, to go up the Oise River and debut the hazardous waste treatment activities that take place there.

At the crossroads of its three original professions, Veolia has developed an environmental concept that begins at the local level, taking into account the unique characteristics and needs of each region in which it operates. We are the opposite of an outside company that extracts value from the territories where it operates: we bring the best of global expertise to create value locally and enable local regions to overcome their specific challenges.

This has been the case from the very beginning. Even though its activity was initially limited to the borders of France, it drew on the hygienist movement and scientific discoveries that were spreading throughout Europe, from Britain to Germany, from Spain to the Netherlands, and even from observations made on the African continent. Ironically, the internationalization of the group took time. The first attempts at foreign development, carried out at the beginning of its existence, from Venice to Istanbul, prestigious as they were, turned out to be unsuccessful. The company only succeeded in this from the 1990s onwards, by aligning itself with the major geopolitical events of the time: the fall of the Berlin Wall, support for the development of African countries, liberalization of economies in Latin America, China's economic boom, and so on. It was also able to bring its expertise to new countries that needed it. With Veolia's decentralized and pilot-controlled group approach, these countries, from Namibia to the United Arab Emirates, have emerged as fertile grounds for innovative ecological solutions that have the potential to inspire the world.

Veolia, as the global champion of ecological transformation and with the recent merger with Suez, has always maintained a strong local presence. It values good governance and recognizes the importance of involving stakeholders in decision-making. By working closely with its teams, Veolia understands the energy that drives a region and the significance of co-constructing services, forming partnerships, and creating alliances to make a tangible impact. The company's emphasis on the human dimension and the labor-intensive nature of environmental protection professions underscores its historical commitment to its employees and the populations it serves.

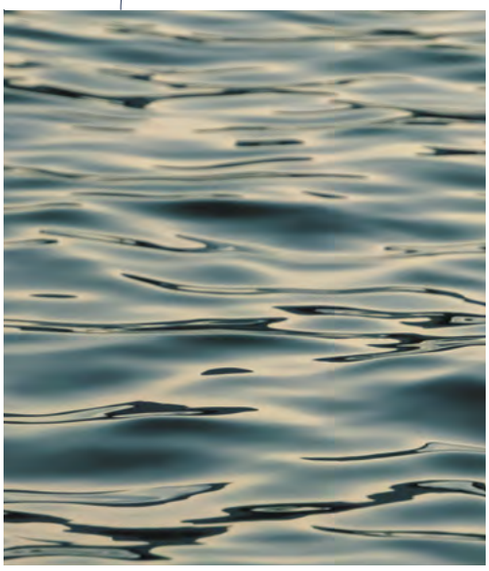
Veolia, from Prosper Enfantin to Antoine Frérot, has etched a distinctive position in capitalist history. It continuously seeks to comprehend society, engage all individuals, and remain focused on company goals—its *raison d'être*. It seeks to make the most of the market economy: it aims to respond to the needs that it sometimes generates and makes those needs the drivers for creating new services to contribute to ecological transformation. At the same time, it is fully aware of its limits and of the need for regulations, even being the one to call for them. This is what makes a "useful" company, to use Antoine Frérot's words.

Through a gradual accumulation of activities and values, we have built a strong and unified company that is capable of tackling the fundamental challenges facing humanity. These challenges, now referred to as ecological challenges, are crucial for the survival and prosperity of our society. Our goal is to create a sustainable world and ensure a better future for all. Veolia is dedicated to addressing various global challenges such as water shortages, pollution, resource scarcity, and greenhouse gas emissions. Through its expertise and experience, it is fully committed to depolluting, regenerating, and decarbonizing the world.

I invite you to delve into this fascinating 170-year journey, constructed under the guidance of the historian Grégory Quenet.

It is a history to which all of you, as citizens, are the heirs. It is through knowing this story that we can continue to be pioneers and to make a difference together ●

Summary



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INTRODUCTION

ENVIRONMENT AT THE CORE

by Grégory Quenet

In the beginning, there was water

In 1853, the term "startup" did not exist. However, this term describes the new Compagnie Générale des Eaux (the General Water Company) exactly: a risky innovation based on the anticipation of new uses for water that had not yet been identified as profitable markets. After 170 years of existence, a formula for success can often appear misleading. Nevertheless, to understand our current circumstances, we need to delve into the past, as it takes one to recognize the other.

"In the medieval era social hierarchy was determined by the availability of water."

During an era of water scarcity, from the Middle Ages to the modern period, water was more a matter of prestige and power than of comfort and service. A strong body odor was seen as a sign of good health, while the line between what was considered healthy and unhealthy was primarily defined by morality and religion. Although there were already some disruptions to ecosystems caused by agriculture, craftsmanship, and human activities in general, no one worried much about the sanitary quality of water. For Parisians of the time period, the "Samaritaine" evoked the image of a machine built by Henry IV to provide water from the Seine to drink. In royal parks and in town, the French court prioritized water as a spectacle over everyday needs, which partly explains Paris's delay in developing a comprehensive water supply network when compared to London. While everyone relied on three main sources—rivers and streams, capturing and transporting water from springs through aqueducts, and digging wells to access groundwater—social hierarchy determined the quantity of water available. In addition, everyone was subject to seasonal variations: low flows during summer and frozen water in winter.

The first half of the nineteenth century witnessed an increase in water supply to households in English cities, but not in major French cities. The latter relied on passive hydraulic systems, using the hydrographic basin that naturally supplied water through gravity, whereas the cities of Albion used coal-powered pumping machines thanks to the abundance and low cost of coal. It was from a sense of Anglophilia that the early private water companies of Paris, such as the Compagnie des Eaux de Paris, founded by the Périer brothers, opted for these expensive machines (which operated until 1858) even while canal water did not seem able to generate much market value; their low maintenance cost gave the deceptive impression of an inexhaustible and almost free supply of water. Compared to England, Germany, and the United States, water

became highly politicized, as its control became a source of rivalry between the French king and the city, and later between the state and the municipalities.

As a result, both the state and the king prioritized water for monumental and strategically important locations for the purpose of social control, and they had little interest in providing water services for all. If Paris, which benefited from a public network of drinking water and sewers, was an exception, it was again for political reasons; during the Second Empire, the aim was to surpass London in developing a comprehensive water supply network.

"The Company's development during the Belle Époque (the Golden Age) aligns with the transformations occurring in the country."

When the Compagnie Générale des Eaux became the first major French capitalist company to focus on general water distribution in cities, it was a gamble. However, it was based on successful examples in England and the United States and, more importantly, on the anticipation of society becoming increasingly water-dependent, putting an end to the era of water scarcity. The urban population in France increased from six million in 1831 to fifteen million in 1891, and then to twenty-nine million in 1954, in a country that was far behind in terms of urbanization compared to other Western European countries (19 percent of French citizens lived in cities in 1831 compared to 44 percent in Great Britain). This economic model proved successful, as it initially combined a profit margin of around 20 percent with a significant reduction in water costs for industries and individuals. For example, thanks to the distribution network of the Compagnie Générale des Eaux, the price per cubic meter dropped from 3.56 francs to 0.82 francs in Nantes in 1854, and from 5.55 francs to less than 1 franc after 1883 for the inhabitants of Rennes. The savings made on water carriers were substantial.

During the Belle Époque (the thirty-five years or so before the outbreak of the

First World War), the company developed alongside the country by equipping major cities, tourist resorts on the Norman and Breton coasts, and finally the industrial cities of the north and east—not to mention concessions in prominent cities abroad, such as Venice, Lausanne, Porto, and Constantinople. If, by the eve of the First World War, three quarters of French municipalities were under municipal management, it was because local elites had gradually and cautiously invested in water networks. The law authorized them to manage their own networks since needs were still relatively low in small communities, and expanding the number of water sources and water treatment was not a priority. The interwar period and, especially, the post-Second World War period bridged the gap between large cities and the rest of the country (only 37 percent of households had running water in 1946, compared to 97 percent in 1975). The system of multiple small, local companies, ill-suited for this scale of demand, disappeared in favor of consolidated expertise.

The emergence of water-dependent societies caused a massive environmental transformation that had not been anticipated in any industrialized country or in the water sector itself, and as a consequence the sector became much more complex. The transition from a few liters to hundreds of liters of consumption per day per person disrupted ecosystems, intensifying the circulation of pollutants and microbes. Thus the water distribution business became intertwined with water treatment, which led in turn to the question of waste and its collection, then to its transportation, then its valorization and incineration, and ultimately, to energy. Therefore, the Compagnie Générale des Eaux grew through the fusion of different needs, which, with each newly acquired market, merged in unique ways and generated new challenges. This constant adaptation, both in France and increasingly abroad, created a dialogue between the world of high-ranking engineers and that of the field and its stakeholders, where unforeseen difficulties, failures, and successes were all valuable lessons.

“The winning companies will be those that can anticipate this water-efficient and sustainable civilization.”

And this is where the flexibility of the French system shines. Instead of favoring a single model like private companies or municipal management, as in England and Germany, France’s water management is characterized by a three-way interplay between the state, municipalities, and private entities. The rules of this game are constantly negotiated, combining the long-term perspective of investments and techniques, the medium-term perspective of new needs and their environmental impact, and the short-term perspective of crises and bills. It is a unique way to manage this common commodity—water—and involves various legal forms of private involvement based on the services required.

As we enter a new water cycle, it is essential to understand how Veolia’s history is deeply intertwined with the water journey: from scarce and aristocratic water to water-dependent and polluting societies. Paradoxically, society’s ability to respond to these challenges in the most privileged areas of the world has led us to overlook the scale of the transformations and difficulties that have been overcome, making networks and hybridizations invisible and creating the illusion of an abstract and readily available water supply without mediation. Today, just as in 1853, the companies that will thrive are those that can adapt—in this case, by anticipating a new era of water efficiency and sustainability. The response to climate and environmental changes is primarily anthropological and cultural, from which technical advancements, regulations, and new markets will emerge. [Continued on page 19]

Chronology

Veolia: Forging a Path through Environmental History

How can we capture the richness of Veolia's rich history? Over the course of 170 years, the company has expanded its activities to include industries that did not exist in 1853. It has grown internationally, undergoing acquisitions and divestments and giving rise to global giants in sectors unrelated to its origins, such as construction and telecommunications.

However, there is a common thread running through its entire existence: its constant ability to adapt to environmental services. Four dimensions have shaped these years and provide insight into how the company's past, far from being a static legacy, is a constantly evolving human and non-human material that reinvents itself to meet future challenges. The men and women who drive the company have successfully established themselves in various territories to develop new knowledge and innovations, addressing changing social needs and aspirations. This confidence in adaptation allows Veolia to approach the crucial new chapter ahead: the reinvention of metabolism and circularity •

GRÉGORY QUENET

1 • Regions

The local region is the foundation. It is always about addressing localized issues: initially, the sanitary problems of the industrial city, then the inequalities within the French territory, and later expanding to the new global space of the 1990s. Today, it involves contemplating the challenges of a planet shared by an infinite number of human societies.

Sanitary city (1853–1920)

1850s
Emergence of technologies. Networks connect transportation, communication, energy, and environmental services.

1853
Signing of the first water sector concession contract in Lyon, a municipality of France.

1860
Signing in Paris of a treaty of "interested management."

1867
Signature by François Grandjouan in Nantes for the first contract to clean the streets of mud and waste and transform them into manure.

1880
The CGE signs a contract for water management in Venice. Constantinople (1882) and Porto (1883) follow.

1884
For the first time, CGE expands its expertise to include the treatment of wastewater in Reims.

Equitable territory (1920–1990)

1909
A sewer system is in place in only 10% of French cities with over 5,000 inhabitants, compared to 36% in Germany.

1920
Beginning of suburban development in the United States, leading to the decentralization of environmental services.

1930–1934
Cities start managing their waste. CGE wins the sanitation contract in Caen and Rennes.

1945
25% of French people in rural areas have access to drinking water at home.

1945
Farm leasing becomes the model contract in France.

1964
Organization of France into 6 major hydrographic basins.

Global geopolitics (1990–2020)

1980
Half of the world's population lacks any wastewater treatment system, with 90% in China.

1989
Complete privatization of the water service in England by Margaret Thatcher.

2000
Signing of a contract between Veolia and the city of Prague, marking the beginning of implementation in former Eastern Bloc countries.

2002
Internationalization of the group, expanding its presence in Namibia, Morocco, China, Japan, and other countries.

Global Geopolitics

1988
Creation of the Intergovernmental Panel on Climate Change (IPCC), a group of experts focused on studying the evolution of climate.

2020
Covid pandemic. Return of the importance placed on public health practices, overshadowed by the prominence of microbiological theories on hygiene convictions.

*The events presented in green on this timeline illustrate some key moments in Veolia's history

2 • Knowledge and innovations

Knowledge and innovations proceed through constant adjustments because ecology is made up of problems that have not been previously thought of. The transition from individual water management to a connected water network at the end of the nineteenth century connected previously separate domains (clean water, wastewater, waste, and energy), which generated new risks that can no longer be isolated from each other, as the very habitability of the Earth is at stake

From Pipes to water network (1853–1890)

1876
The first water meters are installed in Parisian buildings.

1879
Installations pass under the Grand Canal in Venice.

1884
Charles Chamberland invents the Pasteur filter to purify water from microbes.

1886
Commissioning of the Méry-sur-Oise water treatment plant, which combines rudimentary sedimentation with slow filtration through a thick layer of sand.

1890
Following cholera epidemics, microbiological theories prevail among hygienists.

1893
Obligation to deliver purified and filtered water in Paris.

1893
The Bonnain Society invents the reinforced concrete pipe (with metal structure) to replace the cast iron pipe. Society acquired by CGE in 1924.

Sanitary services: clean water, wastewater, waste, and energy

1906
First installation of ozone water treatment for drinking water in France, in Nice.

1912
Creation of CGEA (Compagnie Générale d'Entreprises Automobiles), which sells its Latil Tractor to municipalities interested in mechanizing waste collection. First contract in Paris in 1921.

1914
British engineers Edward Ardern and William Lockett discover the activated sludge treatment.

1937
Creation of Chauffage Service by Léon Dewailly, who invents the principle of energy performance contracts.

1960s
Transition to rapid filtration improves the productivity of factories.

Managing risks

1928
Typhoid fever epidemic of water origin in the Lyon suburbs. CGE creates its own laboratory in Saint-Clair to ensure the purity of the distributed water.

1940
Creation of the first French wastewater treatment plant in Achères.

1964
Water framework law, which allows the creation of water agencies and introduces the concept of "polluter pays".

1975
CGE creates SARPI to ensure the treatment of hazardous waste.

1980
Montchanin discharge scandal. Waste management enters public debate and accelerates its professionalization.

3 • Social uses and aspirations

Anticipating new uses and social aspirations is essential to offer sustainable services in sectors that are not fully addressed by public authorities. The aspiration for comfort, which was long reserved for the elites of modern cities, becomes massively democratized after 1945. This led to a significant acceleration of anthropogenic impact and numerous ecological alerts, which now grew in scale. When the Earth itself is modified by the human species, sobriety became imperative

Comfort and social distinction (1853–1920)

1866
New York becomes the first American city to establish public health regulations.

1883
Under the leadership of Prefect Eugène Poubelle, garbage bins become mandatory in Paris.

1908
Creation of the Fishing-Club of France, which fights against river pollution.

1924
Invention of disposable tissues by Kleenex®.

Democratization, great acceleration, consumption, and alarms (1945–2000)

EARLY 20TH CENTURY
Paid vacations at CGE (before 1936).

1946
5% of households have a bathroom; 37% have running water (97% in 1975).

FROM 1948 ONWARDS
The "Trente Glorieuses" lead to diversification of waste. The concept of waste also grows to include the industrial, medical, electronic, and nuclear.

1960
On average, 250 kg of waste is generated per person per year in France (360 kg in 1990).

1970–1971
Creation of the first environmental ministries in Great Britain and France.

Sobriety and ecology

1994
In Germany, the Green Dot (*der Grüne Punkt*) is introduced by the law on the lifecycle management of products.

1999
Recycling rate in the Northeast United States is 20-25%, 65% in Denmark.

2021
The 14th Chinese five-year plan includes carbon emissions and the concept of "carbon neutrality."

2022
Beginning of the war in Ukraine and energy crisis. Amplification of manifestations of climate change.

4 • Metabolism and circularity

The changes in metabolism, referring to the flow of matter and energy, form the underlying framework for Veolia's extensive entrepreneurial history. Despite the modernity of the services introduced since 1853, they are intertwined with an organic metabolism that requires navigating local disruptions in order to transition into the significant metabolic shift that occurred after the First World War. This shift involved societies becoming disconnected from their natural foundations. As a result, Veolia must now reinvent circularity in order to sustain its existence •

Final years of organic metabolism (1850–1920)

1855
Creation of the Lyon Agricultural Company for Sewage Disposal. (First comprehensive sewer system in Lyon in 1927).

1862
Victor Hugo, in *Les Misérables*, is inspired by Pierre Leroux. In his text "Aux États de Jersey," the philosopher develops an ecological theory ahead of its time, focusing on the use of human waste as fertilizer.

1874
First incinerator put into service in Nottingham, England.

1899
First French waste incineration plant in Saint-Ouen.

1912
The Bièvre River in Paris is buried due to pollution.

1920
Incineration emerges as an alternative solution to waste disposal.

Major metabolic shift (1920–2000)

1913
Invention of the Haber-Bosch process for chemical industrial fertilizers.

1920s
Decline of ragpickers due to the invention of compacting bins that prevent waste sorting.

1948
New York opens the world's largest landfill in Staten Island.

1960
Energy consumption in the United States multiplied 200 times what it was in 1850.

1964
Law prohibits the discharge of untreated wastewater into natural environments by municipalities and industries.

1972
United Nations Conference on the Human Environment held in Stockholm, Sweden.

Reinventing circularity

1970s
Windhoek, the capital of Namibia, ventures into wastewater reclamation.

1972
Adoption of the Clean Water Act in the United States.

1975
First major waste management law in France, obliging every municipality to collect and dispose of household waste.

1988
First French waste sorting facility established in Dunkirk.

1992
Implementation of Extended Producer Responsibility (EPR) schemes.

2022
Acceleration of the circular economy with PlastiLoop, Veolia's new global offering of recycled plastics.

[Continued from page 13]

The Environment's Prelude

The word "environment" appeared in French—fleetingly referenced by geographer Paul Vidal de la Blache in the early twentieth century—as a translation from English. However, it had entered the common language by the 1960s. This decade marked the institutionalization of ecological issues in industrialized countries, as illustrated by the creation of the first Ministry of the Environment in the UK in 1970, followed by the second such ministry, in France. Established a year later, the French ministry was named the "Ministry for the Protection of Nature and the Environment."

The English usage of the word "environment" combines two meanings. On one hand, it refers to the physical context that influences life forms. On the other hand, it represents something that humans did not create and therefore need to understand and protect using the tools of natural sciences. This concept is linked to the term "ecology," which has a different history—the creation of a new scientific discipline in 1866 by Ernst Haeckel, based on the Greek root "oikos," meaning "house," before later referring to nature conservation movements in the 1960s.

"In post-World War II Western society, the term 'environment' refers to a series of issues that need to be managed."

These nature conservation movements soon found their political expressions: the first green party, the Values Party, was established in 1972 in New Zealand, followed by the British Ecology Party in 1973, and Ecology and Survival in France the same year, which many activists wanted to engage in partisan action. In the Western context of post-World War II modernization, the term "environment" referred to a set of problems that needed to be addressed. Initially, it focused on urban planning, but increasingly expanded to encompass ecosystems affected by modernization.

While the French Ministry of the Environment initially concentrated on addressing noise pollution (a new issue in the rapidly transforming cities), the fight against other forms of pollution and the protection of natural spaces quickly became central. This period of history demonstrates how the concept of "environment" evolved, adding existing public policies to the aggregate expertise of technocrats and engineers in order to address new issues as they emerged on the institutional agenda.

In the first *Que sais-je?*[1] book dedicated to the environment, published in 1971, geographer Pierre George acknowledged the versatile and holistic nature of the idea, which even included the sense of "artistic installation" at that time. The term "biodiversity" appeared later, in the late 1980s, with the mobilization of conservation ecologists, though the creation of the Intergovernmental Panel on Climate Change (IPCC) in 1988 initially received little public attention.

"The history of Veolia highlights the importance of reinstating the role of the private sector in driving innovation and developing new knowledge and tools."

This commonly told history of environmentalism gives little space to companies, which are often seen as arriving after these developments, using an already mature science to respond to public demand. Veolia's history shows that this is not the case and that the private sector's contribution to the creation of new knowledge and tools needs to be acknowledged.

The establishment of the Compagnie Générale des Eaux in 1853 addressed a blind spot in public policies: the need to provide water to households. Moreover, the company's development was made possible by an initially

1 — *Que sais-je?* is an editorial collection published by the Presses universitaires in France.

unidentified nuisance: the increase in polluted water volume. But even more interestingly, the company's history reveals the early aggregation of environmental problems to be solved, anticipating the use of the term "environment" and leading to the proposal of new sanitary services a century before the creation of various governmental ministries of the environment.

Water pollution led to waste collection and later to industrial waste treatment. In doing so, the company identified the second major nuisance that characterized the sanitary city after the Second Empire decided to marginalize the famous ragpickers of Paris, putting an end to the systematic reuse of all human products. The classification of certain types of waste resulted in the creation of SARP Industries in 1975 to handle hazardous waste.

Waste issues led to the integration of waste management and transportation companies, such as Grandjouan, established in Nantes in 1867, and the Compagnie Générale d'Entreprises Automobiles (CGEA), fully integrated in 1980, operating in the municipal waste and urban transportation sectors. While the integration of transportation within the scope of environmental ministries remains a point of tension today, Veolia made the strategic decision not to include transportation activities within the company, focusing instead on resource management. Incineration became an alternative to spreading waste, as was practiced in Germany and England. In France, SEPIA (Société d'Entreprises pour l'Industrie et l'Agriculture) and Union des Services Publics, two companies specializing in waste management, joined the group in 1980, the same year that the Compagnie Générale des Eaux gained full control of the Compagnie Générale de Chauffe (CGC), with which it had been operating incinerators since 1967. This led to the development of the energy sector.

"The company functions as an organism, continuously adapting to the evolving dynamics of its environment."

The company's approach—accompanying ecological transformation from its inception—is reflected in a very particular way. The company adapts to evolving environmental issues by continuously inventing new technical, legal, financial, and conceptual tools. The current rise of the energy sector, more in line with the pillars of ecological transformation, demonstrates that this story, in which the company transforms itself to meet contemporary needs, is never finished. Some pages from the company's history, now closed, illustrate this adaptive capacity, which always emerges on the local scale. The investment in the public works sector through the acquisition of Société Générale d'Entreprises (SGE) in 1988 was a strategic response to a stock market takeover bid, but it was also tied to the establishment of networks and the construction of serviced buildings. The integrated management of services at

The Garbage Collectors, by Émile Jacque, 1848-1912.

the building level renews the question of energy renovation and construction methods, while the growing importance of digital technologies multiplies the flows that need to be managed. In telecommunications and media, the logic of flows prevails: if water passes through certain areas, why not also pass cables and, subsequently, content?

This constant adaptation, as expressed through the company's strategic vision, requires a careful balancing act. On the one hand, the big-picture, present almost from the beginning, is driven by the challenge of finding local solutions for each unique context, from which the company must continually learn. For example, the concession of water in Venice in 1879 necessitated the invention of installations capable of passing under the Grand Canal, while in 1893, there was a project to develop purification using potassium or sodium permanganate for hot-weather cities like Saint-Louis in Senegal. On the other hand, and as these examples demonstrate, the international expansion of a French group, based on a different model from that of England, Germany, or the United States, has required it to adapt to distinct national contexts and invent solutions that, in turn, may transform the group's practices. The establishment of the group in Dubai, for example, significantly accelerated the development of digital applications dedicated to customer relationship management and contractual innovations related to energy performance. How do information and innovation constantly circulate to adapt an initial frame of reference to local and international perspectives? Internally, employees have a form of prescience at their respective levels, but these stories, with their successes and failures, deserve to be shared more frequently with the public.

A company is also a living memory, which becomes especially important as challenges re-present themselves on every scale: climate change is accelerating, pollution is reaching the limits of the Earth's ecosystem, and resource scarcity is intensifying. This is a new chapter in a history that dates back to 1853, addressing human responsibility in redefining the relationships between all entities that inhabit the Earth while also redefining the meaning of prosperity. This reflection brings us back to the origins of the word "environment." While the initial etymological research pointed to English, "environment" is actually a French word introduced to England by the Normans in the twelfth century, only to gradually be forgotten in France and later retranslated in the opposite direction. In medieval French, it referred to what "surrounded" a house—barriers or enclosures. So in essence, it encompasses all the connections with water, soil, living beings, and climate—connections that we need to relearn if we are to continue inhabiting the Earth.

Rebuilding, Reconnecting, and Unifying the World

Far from being a detached exercise, the study of history allows us to use the past to envision the future. By understanding where we come from and our contribution to the history of the environment, we can grasp the requirements of a new era. The most recent transformations of the former Compagnie Générale des Eaux demonstrate how its original identity has been maintained throughout its evolution. This predominantly French group, which had withdrawn from international markets after the financial setbacks of World War I, reestablished itself internationally in the 1990s. However, this happened in a completely different context and with unprecedented intensity.

"Environmental services are based on localized assemblies of humans and non-humans."

© Pixabay

The collapse of the Eastern Bloc in 1989 and the rise of emerging countries facilitated by globalization reshaped the global map of environmental service needs. The ideals of health, safety, and comfort that were prevalent in industrialized countries became widespread: the middle class grew from one billion individuals in 1985 to two billion in 2006, three billion in 2015, and four billion in 2021. The geography of this middle class also changed: in 2000, 80 percent of it lived in Europe and America, but that figure dropped to 35 percent by 2015.

Veolia accompanied these transformations in countries where almost everything had to be built from local cultures with their unique needs and strengths. Difficulties were not uncommon, but the ability to learn from local needs (present from the very beginning of Compagnie Générale des Eaux) proved to be an advantage. Unlike most sectors, which can deploy standardized solutions on a global scale, environmental services are based on localized assemblies of humans and non-humans, an inseparable arrangement of materiality and culture that varies from place to place. In this domain, made highly sensitive by its involvement with essential human needs, governance ensures transparency and guarantees quality. However, it also needs to operate with flexibility, refraining from placing limitations on human resources or their solutions.

"Environmental issues with different narratives are increasingly interconnected."

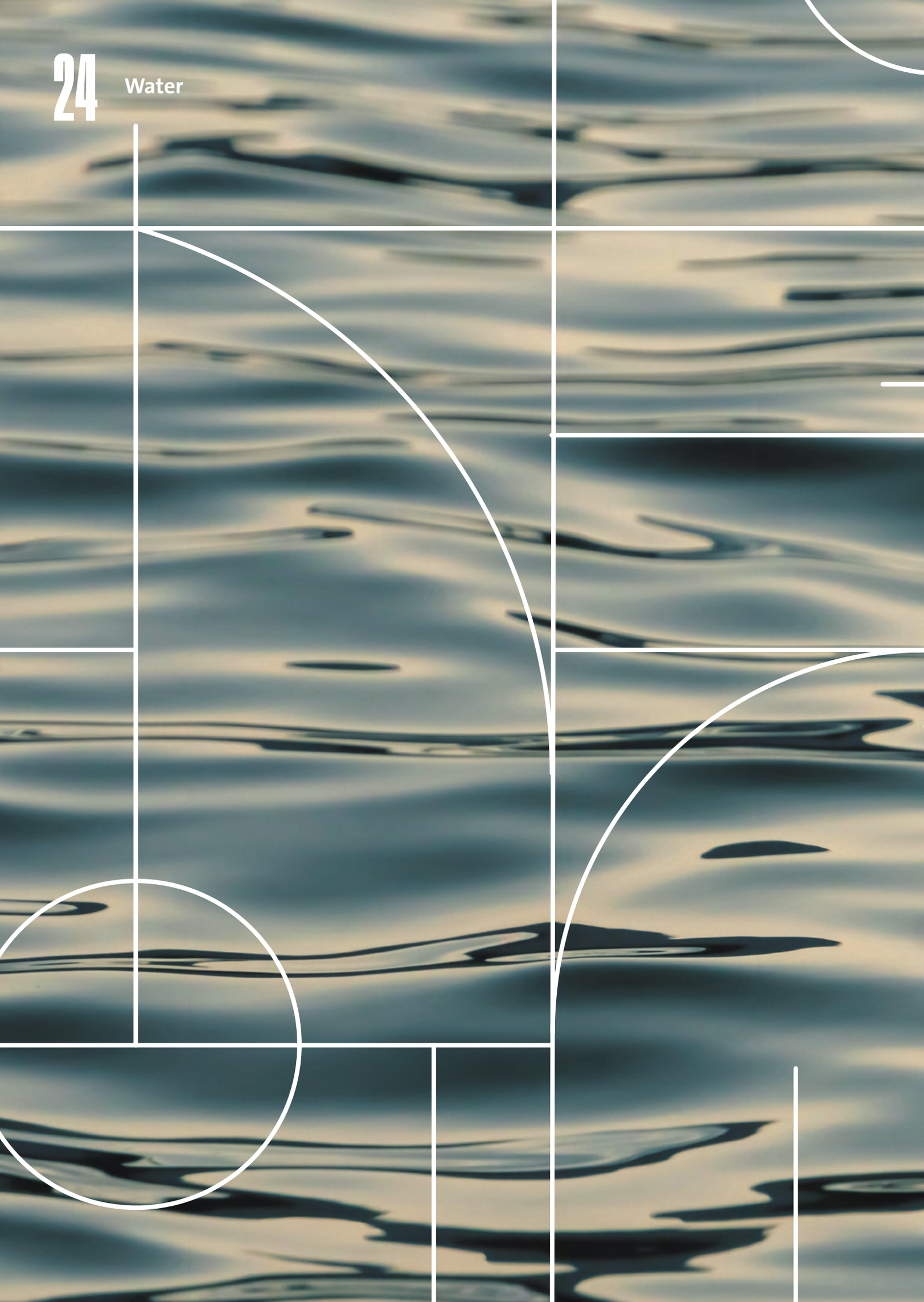
This significant change occurred against the backdrop of triumphant globalization, where production processes have often been fragmented and relocated to achieve economies of scale. However, what used to be a collection of environmental problems with separate stories (water, waste, and energy) has become increasingly interconnected. Starting from its establishment in new territories to meet specific needs, the company has created synergies. In Asia, particularly in China and Japan, the focus on energy has led

to the development of cogeneration and steam networks, later benefiting water for cooling purposes. In Eastern Europe, the need to establish water distribution and treatment networks took advantage of the local expertise in heat production. In Brazil, the management of endless waste has resulted in local energy production. Unbeknownst to anyone involved at the time, what had happened in France was being replicated on a larger scale wherever it was necessary to operate in a new region.

While the Compagnie Générale des Eaux had developed during the progressive interruption of society's organic metabolism from the Ancien Régime, circularity has been reintroduced—but in a new way, as there is no longer an immediate connection to natural elements. Even in the 1850s, pure water had long ceased to be available on-site: the sanitary needs of urban expansion required fetching water from far away, then purifying it and prohibiting the spreading of raw organic waste downstream, creating a new linearity. When Veolia began operating in new countries during its internationalization of the 1990s and 2000s, it became quite different, as hybridizations were legally possible and even desirable. Innovations within the group thus ceased to circulate solely from France to the international arena and instead spread from all countries in all directions, enriching the group's practices based on lessons learned in the new areas of growth.

The ecological challenge of climate change requires us to address a unique global issue within the infinite diversity of human societies. In other words, we have to connect two theoretically irreconcilable scales by inventing a new way of proceeding: decentralized management based on the circularity of material and energy flows. The companies accustomed to working on very concrete and localized processes while mastering the entire decarbonization chain will be the winners. It is an approach that is more qualitative than quantitative, relying on the field teams.

This "landing," to use Bruno Latour's term, is a rediscovery of geography, history, and the human beings attached to them. The lessons of history will be easier to implement for companies that have never forgotten them. However, it is no longer just about addressing industrial and institutional clients: the gradually growing awareness has given rise to demanding public opinion. And this public demands proof that mitigation and adaptation can be reconciled while reinventing an ideal of prosperity ●



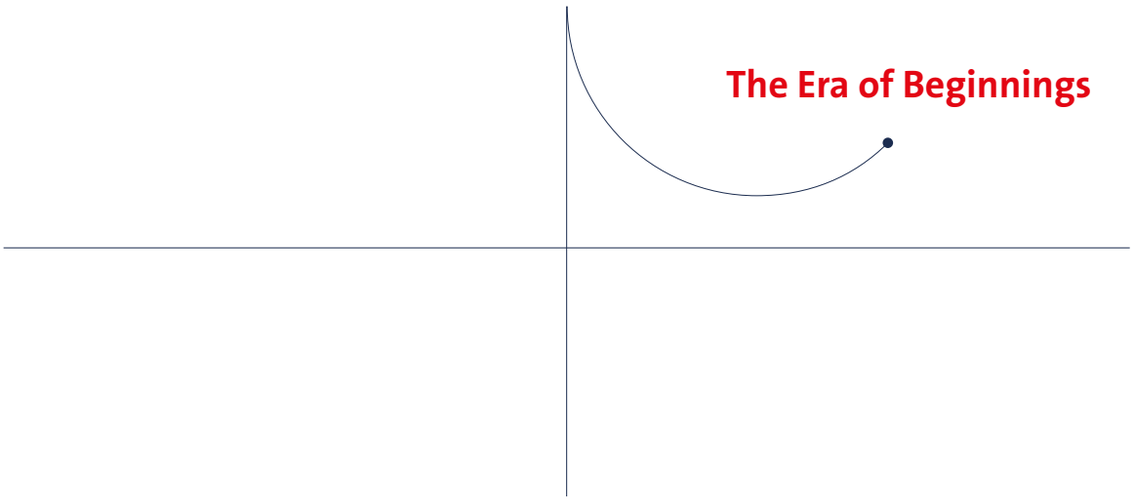
WATER

CHAPTER 1

Water is the most essential natural resource. It is also at the heart of the cultural upheavals that have accompanied the emergence of modern societies since the First Industrial Revolution. As Veolia's original activity, it has been the foundation from which all other activities have emerged since 1853, around which all the others have come together to establish comprehensive environmental protection solutions. Today, climate change and the evolution of our society once again require us to rethink our relationship with this resource, understanding its scarcity and embracing new circularities. These are immense tasks that are already under way.

Story
1

Constructing the Water Supply Network in France



For centuries, aqueducts and fountains mobilized significant capital without necessarily prioritizing universal access to water. Water was scarce, but it was not a primary concern. These constructions were symbols of political prestige and had to be monumental and visible. Inequalities in access to water marked social distinction, which was also reflected in the ability to drink mineral water. In the eighteenth century, no less than thirteen different types of water were sold by the pint in Versailles, not including the fountain reserved for the royal family, and there were twenty-two types available in Paris.

While their invisibility made them less spectacular, water distribution networks brought about a considerable change. While a local water supply through conduits could be ensured by multiple small companies, only national and soon international companies had the technical and organizational capacity to implement these networks on a territorial scale •

GRÉGORY QUENET

The nineteenth and twentieth centuries brought about a complete revolution in water distribution across Europe. It was a development unprecedented since the time of the Romans! The transition from a straight-line model based on Roman aqueducts to a network that served multiple points without hierarchical ordering was a true revolution, driven by individuals motivated to bring progress to their fellow citizens.

From water carriers to public fountains and eventually the widespread adoption of water treatment, water became accessible to everyone within two centuries. The daily lives of more and more of the French were improved until access eventually expanded to encompass the entire population in the second half of the twentieth century. It was during this time that potable water finally began to reach the households of individuals directly, both in urban and rural areas. To achieve this feat, it was necessary to source, store, and transport water, utilizing techniques made possible by the engineering achievements and the political and entrepreneurial will of the pioneers of the Compagnie Générale des Eaux (CGE). This immersion into two hundred years of water history has shaped our practices and our society ●

From Water Carriers to the First Potable Water Networks: A Revolution in Progress

While the nineteenth century indeed marks the beginning of the major water distribution revolution in France, it builds upon centuries of technical innovations. From the dawn of humanity, the search for water sources has been crucial. As early as 6,000 BC, well before the advent of writing, the first wells were established. Water was no longer a resource that could only be obtained directly from a river; effort was required to extract it for use in the same location where it was drawn. Over time and through the centuries, increasingly sophisticated techniques were developed by the early engineers.

As one must render unto Caesar what is Caesar's, credit must be given to the Roman engineers for the remarkable feat of systematizing water distribution to a larger population. Symbolizing the power of the Empire, water became a central element of daily life in Ancient Rome, supplying water to hundreds of thousands of inhabitants through an ultra-sophisticated hydraulic system. The famous aqueducts allowed water to be brought into cities for consumption, while an ingenious sewer system carried away wastewater, sweeping through latrines and converging on the Cloaca Maxima. This extensive canal, serving as a collective sewer, fulfilled three functions: collecting rainwater, disposing of wastewater, and sanitizing the marshes. It remains the oldest drainage system still in use today, as the ancient conduits continue to carry rainwater and debris away from the Roman Forum.

In France, the Pont du Gard exemplifies the legacy of Roman engineering ingenuity. Built in the first century AD, this aqueduct carried, at the height of its glory, thirty-five thousand cubic meters of water each day from Uzès to the city of Nîmes. This scientific marvel, spanning fifty-two kilometers, supplied potable water to the people of Nîmes, as well as to fountains, gardens, and the baths of the provincial capital under Roman rule. These fountains remained fundamental to water supply in cities until the Middle Ages.

Although at that time the concept of sanitation was often neglected, new hydraulic pipelines allowed for the large-scale distribution of water. From the thirteenth century onward, the fountain system developed and provided drinking water directly to cities. Under the Ancien Régime, public fountains multiplied and became accessible to a wide audience. To transport water directly to houses or to the upper floors of buildings, the wealthier individuals employed water carriers. As the number of fountains increased, so did the number of carriers, who sold their precious commodity by shouting "water, water!" In his work *Le tableau de Paris*, published in 1781, writer and journalist Louis-Sébastien Mercier explains that a skilled water carrier could make up to thirty deliveries a day with his two buckets, each delivery representing approximately 25 liters, for up to 750 liters per day.

Another way of bringing water to city dwellers was through canals, such as the Canal de Perpignan, built in 1423 and filled with water in 1425. "The royal canal of Perpignan, which is celebrating its six hundredth anniversary, was primarily intended to supply the city with drinking water. But it also served to provide irrigation water for the city's gardens and crops, supply the six mills along its route, and provide water to the *ulls* —circular water intakes installed on the canal, whose diameter was theoretically standardized to allow for maximum water flow in order to irrigate the authorized lands of Roussillon," writes Dylan Planque, a doctoral student and author of a thesis on the Perpignan canal.

At the beginning of the nineteenth century, public fountains and private wells were the main methods of water distribution in Paris, as well as in other major French cities. Following the French Revolution of 1789, the demand for water increased due to the number of people leaving rural areas for cities. It then became urgent to review the water distribution system in France. And for the French engineers of the time, there was an example to follow: that of the United Kingdom, and London in particular. The capital of the British Empire benefited from a sophisticated distribution network that allowed water to be delivered directly into many households. This service was operated by several private companies that shared the London territory. According to Charles-François Mallet, chief engineer of the Imperial Corps of Bridges and Roads, one-third of London dwellings received water on the upper floors as early as 1830. In Paris, the situation was quite different. However, an attempt was made between 1777 and 1788 with the Compagnie des Eaux de Paris, which managed to build thirty

Water Carrier.

The Water Carrier Portrait

The water carriers delivered water from public fountains directly to the more affluent population's homes, charging two sous for delivery to the first or second floor and three sous for higher floors. The bourgeoisie, meanwhile, sent their maidservants to fetch water from the fountains, which often led to conflicts between servants and water carriers. In 1698, the water carriers obtained exclusive access to the fountains.

In Paris, their numbers increased from a mere fifty-eight at the end of the thirteenth century to twenty-nine thousand by the end of the eighteenth century. The water carriers were equipped with a leather strap placed over their shoulders, with hooks attached at each end to hang the buckets. Nineteenth-century literature and serials frequently highlighted the Auvergne origins of these deliverymen, as Auvergne was a major source of emigration to the capital. They could earn up to three thousand francs per year, provided they made thirty deliveries of twenty-five liters per day.

They sourced water from the receivers, whose task was arduous, while the owners of commercial fountains, whether individuals or filtration companies, made a good living, considering their "presence from 6 a.m. to 6 p.m. (sometimes earlier and later), on-site water delivery, record-keeping, price collection, registration of water carriers, recording delivery times, etc."

Their profession became even more essential as the quality of well water gradually deteriorated, making it unsuitable for cooking or personal hygiene. The workload of those shouting "water, water!" increased when most wells were sealed off and access to fountain water became increasingly necessary.

It was during the Second Empire, with Haussmann's urban renovations in Paris and the implementation of water supply systems in cities, that the profession gradually disappeared, overshadowed by the establishment of water networks, in which engineers from the Compagnie Générale des Eaux played a significant role.

By the eve of the First World War, water carriers no longer existed ●

kilometers of wooden pipes. Unfortunately, the company went bankrupt and was taken over by the city.

To offer Parisians a service similar to that of Londoners, French engineers from the Corps of Bridges and Roads took inspiration from the English model and began the water supply works from the Ourcq River in the mid-1830s, supervised by Louis-Charles Mary. The canal, inaugurated in 1822, supplied water in abundance to the city of Paris. Throughout the country, artesian[2] wells were also dug directly into the groundwater tables to meet the growing demand in cities such as Tours, Paris, Saint-Denis, Mulhouse, Strasbourg, La Rochelle, and Perpignan.

Saint-Simonian thinking considered networks to be the beginning and end of social progress.

However, this activity was not sufficient for the engineers of the time. Those from the Corps of Bridges and Roads and the Polytechnique worked toward establishing real water distribution networks in major French cities. It should be noted that the concept of a network itself influenced their thoughts and actions. This concept emerged from Saint-Simonian[3] thinking, which considered networks to be the beginning and end of social progress. Dominique Lorrain, a research director emeritus at the Centre Nationale de la Recherche Scientifique (CNRS), confirms this: “At that time, cities were being transformed through networks: railway, transportation, electricity, domestic gas, water distribution networks, and more."

The Compagnie Générale des Eaux, at the Heart of Major Construction Projects

In this context, on December 14, 1853, Napoleon III, who, during his years in exile, had witnessed England’s advancement in water distribution compared to France, affixed his signature to an imperial decree authorizing the creation of the Compagnie Générale des Eaux (CGE).

It was the responsibility of the Minister of Agriculture, Commerce, and Public Works, Pierre Magne, to oversee the development of the company. His supervision over agricultural affairs was not unrelated to the mission entrusted to him: even before water distribution in cities, the primary purpose of the new company was the irrigation of fields. In line with the productive logic that drove the first industrial revolution, the main intention of the founders, from Count Siméon to the Duke of Montebello, was to make agricultural lands cultivable and productive that were not yet so. “In 1874, the hierarchy of the two activities would have been reversed,” notes Christelle Pezon, a lecturer at the Conservatoire Nationale des Arts et Métiers (CNAM), even though the company still operated in the Nice region for a few more years: the model of agricultural irrigation could not withstand competition.

Even before the Emperor’s official authorization, the assurance of a water distribution contract in the city was the announcement of the company’s success. However, contrary to the company’s initial ambitions, the contract would not be in Paris: regardless of the delays faced by the French capital, Baron Haussmann and the engineers from the Bridges and Roads assigned to the technical services of Paris did not see the benefit of a private concession to accelerate the deployment of the water network. It would be in Lyon, the capital of the Gauls, that the CGE would sign, on August 8, 1853, with the approval of the Municipal Commission on September 17, the world’s first concession for public water services.

The engineers of the company demonstrated remarkable speed in building the city’s network. “In just four years, the Compagnie Générale des Eaux constructed two large reservoirs, installed three enormous steam pumps (known as Cornish pumps) and their boilers, laid seventy-eight kilometers of pipelines, twenty kilometers of

2 — In an artesian well, water springs naturally from the ground. The trick is to tap into a vein feeding a pressurized water table and use the power of the water to force it out through the well.

3 — A highly influential 19th-century reform movement that proposed a total reorganization of society. Saint Simonism “laid the foundations of an industrial utopia" in opposition to the social order of the Ancien Régime. According to the BNF's Gallica blog, he built the happiness of humanity on the progress of industry and science.

Prosper Enfantin

ENTREPRENEUR OF THE COMMON GOOD

Born in Paris on February 8, 1796, Prosper Enfantin was one of the early administrators of the Compagnie Générale des Eaux and played a decisive role in its beginnings, particularly in obtaining its first contract in Lyon. He embodied an era and a vision of capitalism, one shared by a large number of enlightened industrialists in France of the mid-nineteenth century: Saint-Simonism. More than just a symbol, Prosper Enfantin was one of its leading figures.

Dubbed "Father Enfantin" in the early part of his life, he came from a bourgeois family. As a student at the École Polytechnique from 1813, where he met future followers of Saint-Simonism, he participated in the Battle of Paris in March 1814 to defend the Napoleonic Empire against European Allies, which led to his expulsion from the prestigious school. At the age of eighteen, he found himself working various jobs such as a wine merchant in Germany, Russia, and the Netherlands before returning to France in 1822. During that time, Prosper was initiated into the social and economic theories of Saint-Simon, eventually becoming one of the major figures of this pre-socialist movement after the founder's death.

Saint-Simonism was a broad doctrine encompassing social, economic, political, philosophical, spiritual, and, under the influence of Prosper Enfantin, even mystical aspects. It asserted that people should view themselves as brothers, elevated their association as a principle, and called on them to transcend their individual interests in the name of the common good. It made industry the essential agent of social progress, capable of mobilizing science to guide society toward physical, moral, and intellectual improvement and to make people as happy as possible. With a blend of mysticism and industrialism, this doctrine supported the idea that networks such as canals and railways served universal understanding, and that these physical connections, by facilitating relationships between individuals, could replace conflicts.

To spread this conception of progress, Prosper Enfantin led two newspapers, *Le Producteur* and *Le Globe*, and gathered around him a community of around forty disciples, governed by their own codes and rituals, such as wearing jackets that buttoned in the back to emphasize interdependence. This led to his imprisonment for one year for public moral outrage and illegal association, during which time he sympathized with the prison director. Upon his release, he went into exile in Egypt with some of his close followers. Known as the "Messiah," he embarked on a search for the "female Messiah" and conceived the construction of the Suez Canal, a project that eluded him and was ultimately realized, thanks to his technical data, by the diplomat and entrepreneur Ferdinand de Lesseps.

Upon his return to France after further adventures, he settled in Lyon, where many Saint-Simonians had gone to experience the proletariat. The revolutionary mellowed but did not abandon his principles; rather, he put them into practice and began building networks. He participated in the creation of the Union for the Paris-Lyon Railways in 1845, where he was appointed Secretary General. In 1853, at the age of fifty-seven, Prosper Enfantin, whose mother died in Paris during a cholera epidemic, became an administrator of the recently established Compagnie Générale des Eaux. Writer Maxime du Camp described him as "older than his age" and "weary," while noting his "attractive simplicity and kindness." Regardless of appearances, he mobilized his extensive network—the philanthropist earned admiration from Victor Hugo and Lamartine—to finalize negotiations with the city of Lyon, which had made water distribution one of its priorities. Thus, his aspirations took shape, and networks were established to bring progress to society.

Beyond his professional activities, Prosper remained driven by the Saint-Simonian utopia until the end of his life. In 1860, he founded the Société des Amis de la Famille, which, thanks to donations from wealthy individuals, provided free medical care, helped the unemployed find jobs, and offered retirement benefits to individuals over the age of sixty. Father Enfantin passed away on August 31, 1864, and was buried in the Père-Lachaise Cemetery in Paris ●

sewers, and one hundred twenty water fountains," explains Robert Jonac, from the association L'Eau à Lyon et la Pompe de Cornouailles. Monumental fountains, from Place des Terreaux to Place Bellecour, including Place des Célestins, were inaugurated to embellish the city and celebrate the arrival of abundant water. All these infrastructures rapidly changed the appearance of the regional capital's water supply, freeing it from the "secondary role, the relay role imposed by Paris," to borrow the words of Fernand Braudel in his book *The Identity of France*.[4]

In practice, water was drawn from galleries and filtering basins supplied by the Rhône and the Saint-Clair drinking water production plant, built as early as 1854. These two reservoirs, with a total capacity of sixteen thousand cubic meters, supplied different neighborhoods of Lyon with drinking water. The filtered water was then pumped by three large steam-powered machines, named Cornish pumps. Developed by Scottish engineer James Watt, "these pumps were used in England, in the tin and lead mines of the county of Cornwall; hence their nickname," explains Robert Jonac.

The vital resource was then distributed through a network of pipelines, and residential buildings were gradually connected to it. Granted, tap water was now subject to a fee, unlike public fountains, but its cost was much lower than that charged by water carriers. Thus, a less affluent population, including the silk weavers known as the *canuts* (refers to several workers' uprisings that took place in Lyon, France, in 1831, 1834, and 1848. It is considered one of the major social insurrections during the early era of industrialization), could subscribe and benefit from this fundamental innovation.

In another part of the country, in Nantes, the situation also became urgent: the city had only one public fountain for every hundred thousand inhabitants. A concession contract was signed in 1854, and the Compagnie Générale des Eaux began to draw water from the Loire,

4 — BRAUDEL, Fernand. *The Identity of France: History and Environment*. London: Collins, 1988.

upstream of the city. While some Nantais remained skeptical because "residents who are accustomed to paying the water carrier for their daily delivery do not really perceive the savings when offered a monthly[5] billing," many of them subscribed to "domestic tap" subscriptions, and the city became cleaner thanks to the "sprinkling" of streets and boulevards.

A few years later, the company also intervened in Nice to modernize the water network when the municipality did not have the necessary funds. CGE diversified the sources of supply and improved the city's sanitation, strengthening its reputation as a tourist destination and its attractiveness to the English to the point that the waterfront became known as the "Promenade des Anglais." After initially constructing the Sainte-Thècle aqueduct to transport spring water and the Bon Voyage tunnel-reservoir for storage, they later built the iconic Vésubie canal to meet the needs of the growing population. The canal had three purposes: "irrigation of the hills and serving the municipal irrigation system, providing drinking water to the city of Nice and supplying the coastal towns east of Nice, toward Monaco and Italy."[6] Nice became a symbol of these French coastal cities: ahead of their time, with a modern water network connected to the railway system, benefiting from the presence and influence of the English, who enjoyed it as a holiday destination and investment opportunity. In Arcachon, where CGE also spearheaded the development from 1882 on, the parallel between the water network and the railway system was taken to the extent that "a pipeline of more than sixteen kilometers followed the Cazaux to La Teste railway line."[7]

Back in Paris, Baron Haussmann eventually gave the company his confidence. Under Napoleon III, he had not waited for the company to launch the major transformation works of the capital. To revolutionize the water system, he relied on hydrology specialist engineer Eugène Belgrand. A proponent of "only spring water for supply," as Christelle Pezon specifies, he ensured that Paris was supplied with water from two rivers: the Vanne and the Dhuys. Heavy investments were then devoted to water distribution in the capital. Over 153 million francs were invested in water supply and sanitation between 1852 and 1870. In total, 842 kilometers of new conduits were built, in addition to the existing 705 kilometers. In the midst of this transformation, in 1860, the Compagnie Générale des Eaux became a contractor to the city of Paris for two major reasons. The first is that the company had expanded to the outskirts of Paris by acquiring the Compagnie des Batignolles, the Compagnie de Montmartre, and the Compagnie d'Auteuil. When Paris integrated these municipalities in 1859, it sought to unify its networks and therefore had to negotiate with their owners. The second reason was that the city saw an opportunity to entrust a third party with the task of soliciting new customers and facing competition from water carriers. "It is not enough to bring good groundwater into Paris's network to surpass the quality and price of the water carrier service, [...] it is also necessary to engage in a real street fight with them to ensure that customers connect to the public network."[8]

A little later, the company also took on the role of commercial services, being responsible for meter reading and billing. These devices, introduced optionally in Paris in 1876, would revolutionize the way people accessed water on a daily basis. To understand why, we must delve into how one subscribed to water supply services before the development of these devices. A subscription to the "gauge" provided a fixed quantity of water per day to subscribers, who filled their tanks in the courtyard of the building (as water did not directly reach their premises). The "flat fee" subscription or "open tap" allowed a person to receive an unlimited amount of water directly at home based on a fixed fee. The water meter changed the game with a simple idea: payment based on consumption. Konstantinos Chatzis, a historical researcher specializing in the history of modern engineers, points out that with the development of water meters in Parisian buildings, "the price had to be proportional to the quantity consumed." From then on, all French people were

Water meters have revolutionized the way water is supplied.

5 — DE GMELINE, Patrick. *Compagnie Générale des Eaux : 1853-1959, De Napoléon III à la Vᵉ République*. Paris: Ed. de Venise, 2006.

6 — *Ibid.*

7 — *Ibid.*

8 — *Ibid.*

MAJOR STEPS
IN THE CONSTRUCTION OF THE FRENCH WATER NETWORK

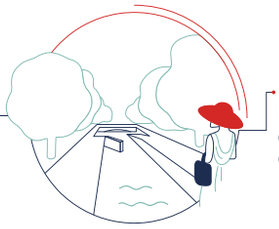
13th CENTURY
Public fountains begin to appear in the streets and gardens of Paris.

50 AD
Construction of the Pont du Gard, scientific masterpiece, 52 meters long, that supplies water to the people of Nîmes and also to the fountains, gardens, and baths of the capital of the Roman province of Augustus.

At the beginning of the 19th century
public fountains and private wells were the main methods of water distribution in Paris.

1777 to 1788
The Compagnie des Eaux de Paris constructs 30 km of wooden pipelines but eventually goes bankrupt.

1425
Inauguration of the royal canal of Perpignan, which supplies the city with drinking water and irrigates its gardens and crops.



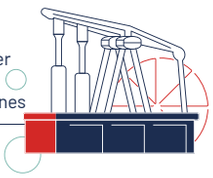
1822
Inauguration of the Ourcq canal in Paris.

1830
Drilling of artesian wells directly into the groundwater tables throughout France.

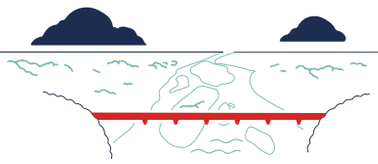
December 14, 1853
Imperial decree authorizing the creation of the Compagnie Générale des Eaux. Napoleon III recognized France's delay compared to England in terms of water infrastructure.

1852 to 1870
Major works by Baron Haussmann, 3/4 of Paris's administration is entrusted to him for the supervision of the water system. He aims to rely solely on spring water for the water supply, specifically from two rivers: the Vanne and the Dhuys.

1853 to 1857
The CGE (Compagnie Générale des Eaux) constructs the drinking water production plant in Saint-Clair, along with two large reservoirs for storage. They also install enormous water pumps known as *ornouailles* and their boilers, and lay over 150 kilometers of pipelines and sewage systems to cover the city.

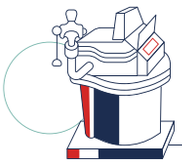


1854
Signing of a concession contract between the CGE (Compagnie Générale des Eaux) and the city of Nantes; water is drawn from the Loire River.

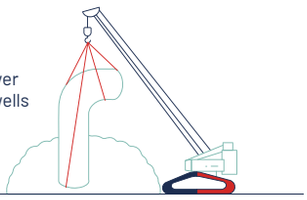


1860
Signing of a treaty for a mutually beneficial agreement between Paris and the CGE (Compagnie Générale des Eaux) to collect subscriptions from Parisians, while facing competition from water carriers.

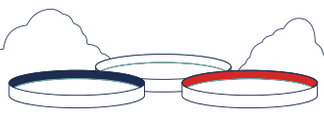
1876
Installation of the first water meters in Paris



At the beginning of the 20th century,
many cities with a population of over 10,000 still relied on fountains or wells for their water supply. However, reinforced concrete water towers gradually replaced the cast iron pipes of Chameroy.

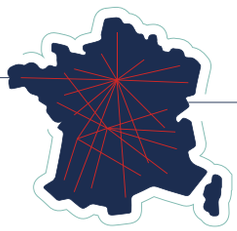


1940
First wastewater treatment plant inaugurated in France, in three-quarters of the cities.

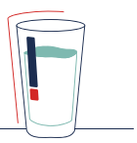


1950 to 1970
The French landscape is adorned with water towers, to pressurize water and deliver it everywhere at a good rate of flow.

1960 to 1980
475 000 km
of water network are installed in France, equivalent to about 1,500 kilometers per year on average.



Late 1980s
99% of the French population has access to running water in their homes.



In 2023, France has **996 000** km
of drinking water network, which delivers water to everyone 24/7.

treated equally: they had access to abundant drinking water at home and directly paid for what they consumed.

While the hydraulic situation in the capital and in some cities had progressed significantly by the end of the nineteenth century, disparities remained pronounced between different French municipalities, especially between urban and rural areas, at the beginning of the twentieth century. Christelle Pezon's book, *Le service d'eau potable en France de 1850 à 1995*, says that at the beginning of the twentieth century, "148 cities with over 5,000 inhabitants had only fountains or wells."[9] In rural communities, home water distribution was virtually non-existent, as "water distribution networks did not reach the countryside in the nineteenth century," Pezon adds. It would take the *Trente Glorieuses* (the period of economic growth in France from the 1940s to the 1970s) for rural areas to access tap water: in the early 1940s, only 25 percent of rural areas had access to domestic drinking water.

Between Rural Modernization and Urban Demographic Explosion

The first part of the twentieth century did not see any major technological innovations in water distribution, and the main projects focused on expanding water supply and distribution networks. However, two important developments occurred after World War I.

In 1918, the Compagnie Générale des Eaux extended the scope of its activities by creating Sade, or the Auxiliary Water Distribution Company, to vertically integrate its value chain and directly handle the installation of water pipes. After participating in the war effort, Sade was also involved in the reconstruction of networks in areas affected by the fighting. In 1924, the company integrated Bonna, whose reinforced concrete pipes, invented by Aimé Bonna in 1894, provide an innovative solution compared to the cast iron Chameroy pipes, which are more suitable for gas transportation. Moreover, by utilizing Bonna's pipes, the company was able to avoid the high tariffs imposed by Pont-à-Mousson, its supplier, especially during times of high inflation.

During World War II and onward, the country faced significant new challenges: it had to help rebuild the nation, cope with rapid urbanization, and meet the growing demands for modern comforts from its citizens. As historian Jean-Pierre Goubert pointed out in a 1984 article, "Comfort was still not widespread in the country" in 1946.[10]

Profound changes in lifestyles were underway, made possible by massive construction projects throughout the country. The iconic representative of this new era was PVC, which, thanks to petroleum chemistry, enabled the production of durable and lightweight pipes for water distribution on an industrial scale by the mid-1960s. The Compagnie Générale des Eaux adopted this new material, which, according to David Colon and Jean Launay, made possible "the water miracle in France."[11]

Between 1960 and 1990, two revolutions took place: hundreds of thousands of kilometers of water networks were installed to supply water to households, and tap water finally became widely available in rural areas, paradoxically occurring at a time when France was experiencing a rural exodus. The numbers are impressive: from 1960 to 1980, 475,000 kilometers of network were laid, equivalent to an average of one hundred kilometers per day. This network extended to every corner of the country, facilitating the arrival in households of washing machines, indoor toilets with flush systems, and bathrooms with water heaters. Bathrooms themselves

Between 1960 and 1990, hundreds of thousands of kilometers of water networks were installed to supply water to rural areas.

9 — PEZON, Christelle. *Le Service d'eau potable en France de 1850 à 1995*. Paris: CNAM, CEREM, 2000.

10 — GOUBERT, Jean-Pierre. « La France s'équipe. Les réseaux d'eau et d'assainissement. 1850-1950 ». *Les Annales de la recherche urbaine*, no. 23-24 (1984).

11 — COLON, David, LAUNAY Jean. *L'eau en France, entre facture et fractures !* Paris: Nuvis, 2017.

Construction work on the Lyon water network.

underwent modernization, with architects proposing different types of spaces and designs, ranging from simple shower cabins to large bathrooms resembling personal spas, as highlighted by the Passerelles website of the National Library of France. An illustrative example of this dynamic was the number of subscriptions to the Compagnie Générale des Eaux (CGE), which surpassed 633,000 in 1954 and reached 772,000 in 1958.

Between 1950 and the 1970s, France also erected numerous water towers or elevated reservoirs. These storage facilities, located between treatment plants and end-users, primarily served to pressurize water: the elevated reservoirs utilized gravity to apply the required pressure for supplying water to taps at lower altitudes. Today, there are approximately sixteen thousand water towers in France. As a result of this frenzy of network construction, from taps to reservoirs, treatment plants, and water towers, 99 percent of the French population had access to running water at home by the late 1980s,, with good pressure, twenty-four hours a day.

Through the principle of public service delegation and the economic growth during the Trente Glorieuses, the French government was able to reduce inequalities between major cities and rural areas and promote peri-urban urbanization. Major private companies like CGE have thus accompanied the exceptional development of the Île-de-France region from the 1960s until today. In the northern and eastern parts of Paris, the creation of the Annet-sur-Marne water treatment plant by the Société Française de Distribution d'Eau, a CGE subsidiary in the early 1970s, was intended to supply water to the new town of Marne-la-Vallée and support the urbanization of surrounding suburbs. However, it was not just about water supply; this development also benefited the socio-economic fabric of the region. Notable milestones in the increasing prosperity of the Île-de-France region included the founding of Charles de Gaulle Airport in 1974, the Paris Nord 2 business park in 1981, and Disneyland Paris in 1992. Another network, the A4 motorway, which gradually took shape during the 1970s, also played a crucial role. Ultimately, the Annet-sur-Marne plant, still operated by Veolia, provided water to 500,000 residents in the northeastern quarter of the region.

According to Eric Issanchou, Technical Director of Veolia's Water activity in Île-de-France, the region's strength lies in the interconnection of networks and production facilities. "We are an interconnected zone that allows, regardless of the operator, the networks to secure each other," he says. In summary, this situation ensures a secure water supply for the over four million inhabitants served by Veolia and other operators in the region, thanks in large part to the reservoir lakes constructed upstream of

the Seine river basin (which includes the Aube, Marne, Seine, and Pannecière). Today, private companies are no longer responsible for infrastructure investments but can focus on service operation. This is known as a "concession contract." Historian Konstantinos Chatzis adds, "After World War II, the state intervened heavily to finance the networks. The funds benefited small communities rather than large urban centers. We witnessed a transfer of infrastructure financing."

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In looking back at the foundations of what Veolia has become, it is worth noting that before becoming one of France's industrial flagships, the company was initially a startup, even though no one would have dared to call it that in the nineteenth century. It entered a market where the need was uncertain. It underwent significant strategic and commercial repositioning in its early years. And from the beginning, it had a considerable capital of 150 million francs, which, although reduced later on, allowed it to start with a strong financial base and avoid the same fate as the Périer brothers' Compagnie des Eaux de Paris, which remains a small and undeveloped SME.

By investing in water distribution, the Compagnie Générale des Eaux had a major impact on the society that nurtured its growth. One hundred and seventy years after its founding, the water distribution network supplies the average French person with 150 liters every day. France now has 996,000 kilometers of drinking water network, an extraordinary public asset that ensures almost the entire population is served continuously. Today, Veolia provides drinking water to nearly one in three French people.

Thanks to the expertise gained in its country of origin, Veolia now serves more than 111 million people every day worldwide. Cities such as Prague, Budapest, the Pudong district in Shanghai, Shenzhen, Bogota, and Santiago de Chile trust Veolia. Its international presence allows for the rapid improvement of network management skills at a time when challenges remain acute, with aging networks in need of maintenance and renewal and one in three people worldwide still lacking access to safe water, according to the World Health Organization ●

Today, Veolia provides drinking water to nearly one in three French people.

FRANCE

Investing in Ecological Transformation: A "Made in Marseille" Lesson

In 1834, Marseille was devastated by a cholera epidemic that claimed over three thousand lives. The municipal team in place decided to address the identified culprit head-on: the city's unsanitary conditions and inadequate water supply, which amounted to no more than one liter per person per day. To tackle this issue, they embarked on the construction of the Marseille Canal to bring abundant water from the Durance River to the Phocaean city. It was a political priority, with Mayor Maximin-Dominique Consolat determined to carry out the project "whatever happens, whatever the cost." The means were indeed found, and the canal was inaugurated in 1854. The annual construction work represented a budget equivalent to that of the entire municipality for fifteen years.

This figure is interesting to put into perspective. In their 2023 report on financing the climate transition in France, Jean Pisani-Ferry and Selma Mahfouz mention the need for France to mobilize 34 billion euros of public spending over seven years to achieve the target of a 55 percent reduction in greenhouse gas emissions by 2030. That represents, relative to the 1,500 billion euros of annual public spending, only 2.2 percent over a period half as long—in other words, nearly one hundred times less effort than what Marseille undertook for the construction of the canal. This serves as a reminder that the investments required to guarantee ecological transformation are entirely realistic in light of history, provided there is collective will ●

SPAIN

Barcelona, a Story of Great Transformation

From Miró to Dalí, from Chagall to Picasso, numerous twentieth-century painters have lived in Barcelona. The city is renowned for its architecture, energy, and vibrant colors that ignite the imagination. However, like many European cities, Barcelona would still be an unsanitary cesspool without the arrival of water in the second half of the nineteenth century. Water lies at the heart of the radiance of the Catalan capital.

When evoking the renewal of Barcelona in the late nineteenth century, one first thinks of the Sagrada Familia and Antoni Gaudí. The destruction of the city walls and the Cerdà Plan allowed the city to combine industrial dynamism with urban expansion, facilitating exceptional architectural audacity.

This urban development policy, like in many other European cities at the time, also aimed to address public health concerns related to the proliferation of diseases such as cholera. In 1867, the Barcelona Water Company was established in response to the challenges raised by the Cerdà Plan. Just four years later, the water network was operational, featuring an aqueduct, twenty-two viaducts, and forty-seven tunnels, delivering water from the Dosrius aqueduct to Barcelona (roughly forty kilometers apart).

During the 1888 Universal Exhibition in Barcelona, which showcased Catalan modernism and officially marked the beginning of this artistic era, the company, now known as the "General Society of Barcelona Waters or Aigües de Barcelona," presented a fountain comprising water features and lights—now disappeared—

in the Ciutadella Park. It also supplied water to the fountain in the famous Plaça Catalunya. These remarkable achievements illustrate the central role of water in the radiance of the Catalan capital.

In the 1920s, the General Society of Barcelona Waters had a distribution network spanning 900 kilometers, covering the entire city of Barcelona and neighboring municipalities such as the Hospitalet de Llobregat, Montcada, and Badalona. It served 44,000 subscribers. The company actively participated in the 1929 International Exhibition, providing the necessary technology and water for the Magic Fountain of Montjuïc.

Three decades later, the company supplied water to 250,000 customers, notably through the opening of the Sant Joan Despí treatment plant, the first major facility of its kind in Catalonia. By the end of the 1960s, the company had nearly more than 6,000 customers. And at the end of the twentieth century, it contributed to addressing the challenges posed by the population growth Barcelona experienced during the 1992 Olympic Games.

But the history of Aigües de Barcelona extends beyond the city itself. In the 1970s, the Agbar Group was formed in order to diversify, particularly in sanitation, and to share its expertise with other regions, starting with Chile in 1999 through its investment in Aguas Andinas. “Companies must constantly transform and evolve according to the needs of our society, to face the challenges that arise and maintain the trust of customers. This is the story of the Agbar Group, which expanded to share the experience gained in the water sector with other countries, always driven by the same desire to innovate,” explains Ángel Simón, President of Agbar and Director of the Iberian and Latin American zone. In 2005, the company inaugurated its new headquarters, the Agbar Tower, in its birthplace, becoming one of Barcelona’s architectural and tourist landmarks.

Since the early 2000s, faced with severe droughts affecting Catalonia, Agbar has developed expertise in water usage efficiency, network effectiveness, and water supply solutions. Agbar has contributed to the development of the El Prat desalination plant.

The company has also demonstrated its capacity for innovation in the recovery and reuse of wastewater, which has advanced since the implementation of the reverse osmosis treatment line at the Baix Llobregat wastewater treatment plant. Recovered water now represents 25 percent of the water resources used for supplying the metropolitan area of Barcelona for industrial, agricultural, and urban purposes, such as street cleaning and watering green spaces.

The integration of Agbar into Veolia in 2022, along with most of the international activities previously held by Suez, provided an opportunity to accelerate the sharing of expertise worldwide, reaching even Northern Catalonia in France, in Saint-Cyprien. The mobilization of Catalan ultrafiltration expertise has made it possible to consider producing recycled water that can replace water from the water-deficient Villeneuve-de-la-Raho lake ●

FRANCE

Between Industrial Revolution and Thermal Water: The Fascinating Story of Le Touquet-Paris-Plage

What connects the daily newspaper *Le Figaro*, the Prince of Wales, Veolia, and the rise of nineteenth-century railways? It's Le Touquet! Behind this peaceful seaside resort lies a remarkable gamble: transforming a hamlet on the Opal Coast into a beach resort that would rival Cannes or Biarritz.

Le Touquet-Paris-Plage, a legendary seaside resort located on the northern coast of France, embodies the perfect blend of elegance and history. In the nineteenth century, a Parisian notary named Alphonse Daloz acquired the Domaine du Touquet, a hamlet mainly composed of sand, with the intention of transforming it into a vast pine forest. His plan quickly changed when Hippolyte de Villemessant, the founder of *Le Figaro*, suggested developing it into an exclusive resort for Parisians. Thus, in 1882, Paris-Plage was born. Within just one year, it had attracted around thirty residents.

Two British men, John Whitley and Allen Stoneham, captivated by the untapped potential of this charming coastal region, set out to turn this dream into reality. Their adventure began when they acquired untouched lands north of the Canche estuary. Their ambition was to transform the village into a luxury seaside resort. Water played a crucial role at the heart of this audacious venture, as there was initially little infrastructure—not even running water.

Firstly, a robust water distribution system was established, even before it was implemented in major French cities. An outbreak of typhus in 1898 raised suspicions of well contamination, as these wells provided water to the villas and for sanitation purposes. This accelerated the deployment of the water system.

In 1904, realizing that the initial water resources would be insufficient to supply the expanding region of Le Touquet, the family-owned company Eaux de Berck-sur-Mer drilled a fifty-meter-deep well in the Rombly area, which was previously a flooded zone. This pumping station, known simply as "Rombly," had a remarkable feature. Its water, renowned for its therapeutic qualities due to low nitrate levels, could be used without any chemical treatment. Recommended for liver and kidney disorders,

the water was even sold in bottles. Its reputation was such that a pavilion was built in the garden alongside the castle park, allowing visitors to taste the water, further enhancing the station's reputation.

The development of the seaside resort gradually transformed a tranquil expanse of dunes into a bustling tourist destination. The choice of the name "Le Touquet-Paris-Plage" was not a coincidence. By associating the name of the French capital with the seaside resort, Whitley and Stoneham aimed to attract the attention of the Parisian aristocracy, who were always eager for exclusivity. Everything was done to encourage them, with the Nord railway and the Étaples-Paris-Plage electric tramway line, inaugurated in 1900, allowing city dwellers to reach the seaside in just three hours. Le Touquet-Paris-Plage became an ideal destination for urbanites seeking relaxation and entertainment.

By the early twentieth century, success had been achieved. The British high society in particular flocked to this haven of peace, rivaling the most prestigious Europe's other tourist destinations. Prominent personalities, artists, and renowned writers such as the Prince of Wales, Edward VIII, and Noël Coward succumbed to the charms of this seaside resort.

The First World War brought new challenges, however. Devastating battles had a major impact on the region, destroying a significant part of the resort's infrastructure. However, the colossal post-war reconstruction effort allowed Le Touquet-Paris-Plage to survive these hardships and restore its former splendor. The Compagnie Générale des Eaux (CGE), despite facing its own challenges, invested in the area: "It was after 1914 that the first concessions were acquired in various neighborhoods of Le Touquet," recalls Jean-Claude Douvry, former CEO of Sade, who was responsible for operating the network at one point. "This period, marked by rising energy costs and inflation, posed challenges for water distribution companies." This ability to seize crises as opportunities for growth became a constant factor in the company's growth.

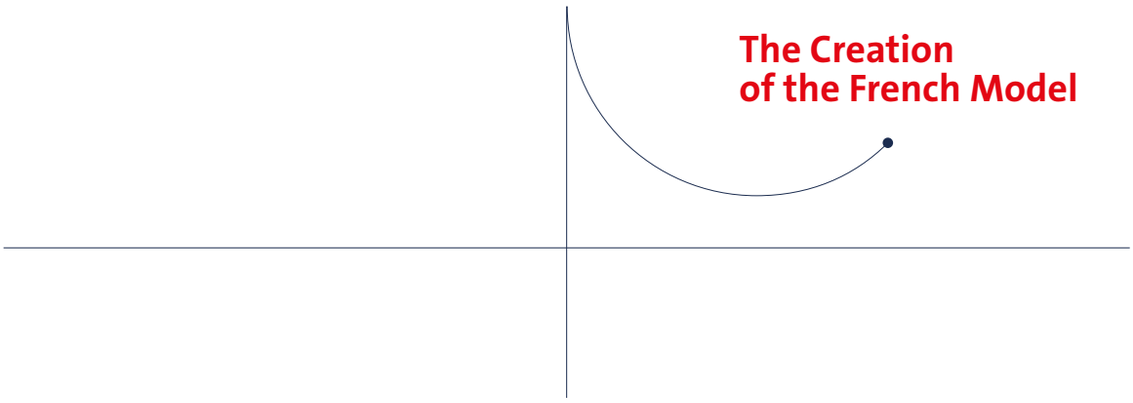
Until the conclusion of World War II, the independent Société des Eaux du Touquet distributed gas and electricity along with water. However, after the nationalizations that followed the war, CGE focused exclusively on water supply. With the advent of modern comforts, the increasing demand for water far exceeded the capacities of the Rombly station, especially during the summer periods in Le Touquet-Paris-Plage and its surroundings. To tackle this new chapter on the Opal Coast, a comprehensive reinforcement program was launched. In 1989, CGE acquired Société des Eaux du Touquet, demonstrating that its development involved resilience in the face of fragile local companies and sometimes even picturesque acquisitions: "The company was acquired from its owner Daniel Vinay through a developer working with Bernard Forterre, who happened to know Madame Vinay's first husband. It was not without difficulties, as the religious society of Father Halluin, on the other hand, was not willing to sell," recalls Jean-Claude Douvry. One of the company's notable achievements was, in the early 1990s, "redirecting the route of the A16 motorway" away from areas that could have posed pollution risks to the Rombly source.

Today, Le Touquet-Paris-Plage continues to draw visitors from around the world. This historic seaside resort has preserved its unique charm by cultivating an intimate relationship with water, a source of life and renown for this rare gem on the Opal Coast ●

Story
2

Water Network Management

The Creation of the French Model



To understand the specificities of the French organization, one must start with a two-player game between the state and the local authorities. Over time, this dynamic has transformed into a tripartite game encompassing the state, local authorities, and private enterprises, all working together to fulfill the demands of users.

Indeed, the Ancien Régime bequeathed two types of water. On one hand, there were the royal waters: straight lines which water privilege holders tapped into. On the other hand, there was water management by cities, focusing on sensitive areas of public space such as barracks, hospitals, schools, and public fountains. Consequently, water supply to residential areas was neglected in France, and private companies took charge of it. However, they couldn't adopt the English model of pumps drawing water with cheap and abundant coal, as in the United Kingdom.

The involvement of three players in this model has demonstrated remarkable flexibility. It enables the terms of the contract to be modified as needed to confront emerging challenges and distribute responsibilities effectively. By doing so, it effectively mitigates the risks associated with long-term underinvestment or bankruptcy, risks that are often prevalent in single-player systems, as observed in the United States ●

GRÉGORY QUENET

The French may not realize it, but the model that has governed their water and sanitation service for over a century has inspired the world. In fact, French companies in this sector are internationally recognized, with Asian, African, Middle Eastern, and North and South American countries turning to them to manage water services. Since the early twentieth century, companies such as the Compagnie Générale des Eaux (CGE, now Veolia), Lyonnaise des Eaux (now Suez), and SAUR (Société d'Aménagement Urbain et Rural) have engaged in fierce economic competition. Each of these companies has its own specific culture, but all three have contributed to the development of what is known as the French water model. This model is based on a public-private partnership (PPP)—the delegation of public service and the principle of "water pays for water," which largely relies on subscribers to finance infrastructure rather than governments.

By developing expertise in water treatment, these companies have also enabled the sourcing of water closer to users, from surface or underground sources. The goal was to avoid laying pipes far away from homes to access better water, which initially resulted in significant losses in places like California and Spain. Thanks to this strategy, water has remained a highly localized service in France, rather than being managed by a central authority. The sector gradually established itself as an industrial activity that required substantial investments. By gradually integrating the entire value chain, from pipe manufacturing to wastewater treatment plant construction, both the Compagnie and the Lyonnaise became indispensable in the public services landscape. However, these private companies could have disappeared multiple times "at their own risks and perils," as stated in concession contracts. Research conducted by CNRS researcher Dominique Lorrain on these companies demonstrates that the "French water model" was not conceptually designed by different stakeholders in advance. It is, in fact, the result of multiple adaptation strategies employed by various parties in response to different situations and challenges ●

Between the State and the Cities: The Birth of a Model

Challenging Beginnings

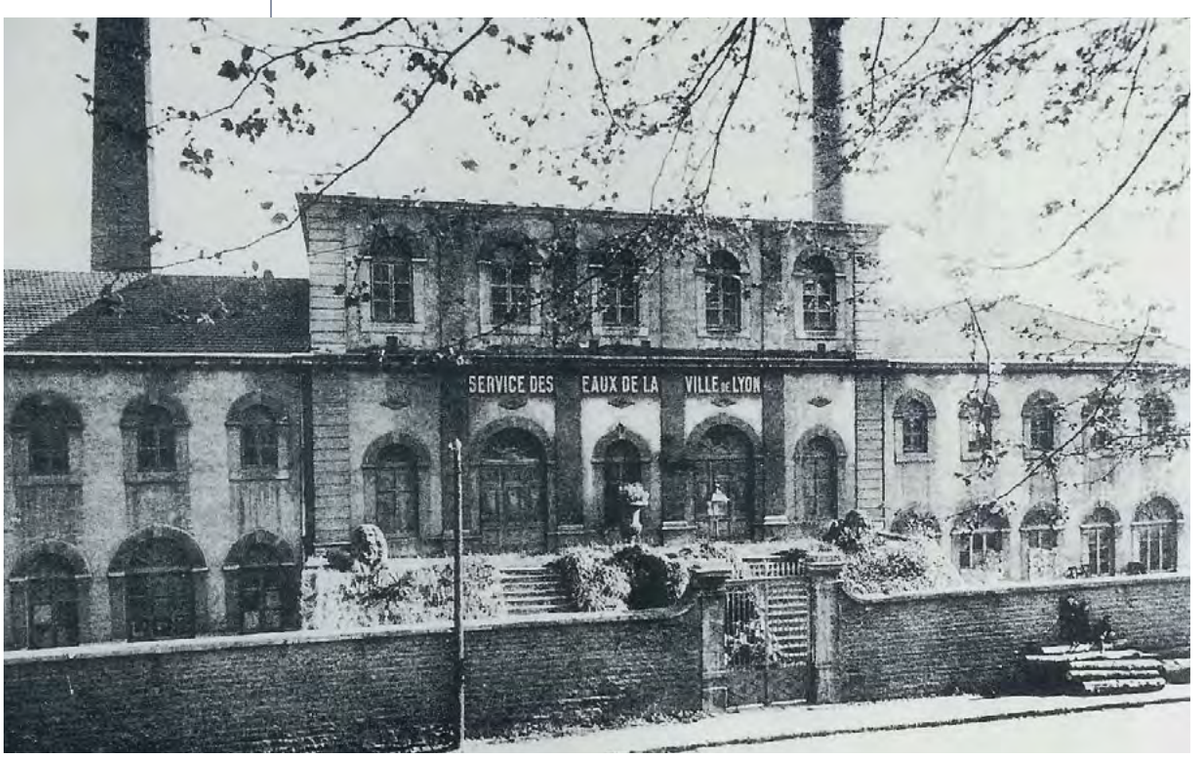
Far from being a smooth journey, the history of the French water model is turbulent. When Compagnie Générale des Eaux was established in 1853, twenty-seven years before Lyonnaise des Eaux, it had to create almost everything related to water distribution as we understand it today. Even though there were modest water distribution services under consideration locally (such as the project by engineer Jégou in Nantes, later taken over by CGE in 1853) or already in existence (like the Société Générale des Eaux de Nice in Nice, then part of the Kingdom of Piedmont, acquired by CGE in 1864). During this time, the relationship between municipalities and private operators could be contentious because, according to French law, it was the municipality's responsibility to provide potable water distribution. This prerogative, reaffirmed by the municipal law of 1884 for reasons of public order and hygiene, said that the municipality decides whether to enter into a contract. Private operators faced the possibility of municipal takeover, or *regie*, in which the municipality would take over the direct management of water services, as early as the 1880s. This debate between regie and public-private partnership would shape the history of drinking water in France up to the present day.

Beginning in the late 1870s, disputes arose between the Compagnie Générale des Eaux and certain municipalities. Such was the case in Nantes, for example, where the two co-contracting parties struggled to reach an agreement on who should finance the replacement of a deteriorating Chameroy pipeline, which had developed significant leaks. The water quality was also questioned by the municipality, which expressed its desire to repurchase the concession as early as 1895. Ultimately, Nantes repurchased its water service and transitioned to municipal management in 1900, even though the contract was supposed to run until 1914. Other cities soon followed suit: Lyon (repurchased in 1900, before the contract's original end date of 1952), Rouen (1912 instead of 1941), and Toulon (1912 instead of 1944). In the early twentieth century, water distribution became a more profitable venture, especially for larger cities with partially established networks and the means to extend potable water services to new neighborhoods. It also became a matter of public hygiene and met the expectations of residents: local authorities wished to manage the service themselves, even though the high compensation entailed by the early repurchases of concessions represented uncertain economic interests.

Through Precedents and Legal Decisions, a More Precise and Robust Model Emerged

Before World War I, two out of three cities with over five thousand inhabitants were managed by municipal authorities for water distribution, abandoning the concession system that had previously prevailed, where the community delegated the management of its water service. While the Compagnie Générale des Eaux (CGE) had been instrumental in developing water infrastructure in major French cities, whether industrial (Lyon, Lille, Lens) or tourist destinations (Nice, Antibes, Menton), it was now under threat in many of its strongholds.

However, the Company faced challenges by diligently defending its rights when necessary. "It was a structuring agent during disputes with municipalities," says Christelle Pezon, a French professor and drinking water expert. "It appealed to the Council of State, in order to establish legal precedents. The Company has contributed



Old photo of the Saint-Clair factory (Lyon), circa 1910.

British and German Water Distribution Models

In the second half of the nineteenth century, England and Germany were ahead of France in terms of domestic water distribution. The cities in both countries industrialized faster and faced significant sanitation issues that had to be addressed through water distribution and treatment. However, the national historical context in which these services emerged did not allow for the establishment of benchmark companies.

In England,
the demand for water was so high that it had to be sourced from distant locations or treated on-site, resulting in substantial investments. The real cost of water increased by 50 percent during the nineteenth century, and private companies were not willing to engage in this market due to inefficient billing systems. As a result, municipal authorities took over water services, benefiting from the ability to charge for water through taxation indexed to property value. This ensured stable revenues regardless of actual water consumption. The hygiene argument also played a significant role in England, even earlier than in France. The Public Health Act of 1848 entrusted local authorities with "the responsibility for water supply and empowered them to enforce their will over local water companies." In 1914, English municipal administrations reached their peak, followed by a strong regionalization of services, divided into ten hydrographic districts. Later on, water services were nationalized in 1973 and then privatized in 1989 under Margaret Thatcher's government. However, users began to perceive a decline in service quality, similar to the waste management sector.

© Ehsan Hasani

In Germany,
cities have always had more power and autonomy than in France. In the nineteenth century, the Prussian state reserved the option for municipalities to create municipal enterprises known as *Stadtwerke*. Consequently, by the early twentieth century, thirty-eight out of forty-one German cities with over 100,000 inhabitants managed their own water services. Over time, these enterprises also consolidated various public services within their operations (transportation, energy, etc.), effectively monopolizing matters related to residents' well-being, similar to what is sometimes called the "welfare state" in France. For the population, municipalities could even be seen as a safeguard against the despotic tendencies of the central state. This proved to be a successful approach, as these municipal utilities or Stadtwerke survived wars and the Third Reich and continue to exist today, particularly through the *Länder*. However, this system did not foster the emergence of an industrial champion capable of leading global innovation in the sector, despite Germany's success in many other industries ●

Percolation basin, Saint-Clair water treatment plant.

to shaping the law around this type of contract, which subsequently constrained all parties involved."

Between 1880 and 1920, CGE was involved in one-third of the decisions made by the Council of State. Alongside the evolving concession model, which struggled to align the interests of local authorities and the company, the concept of *affermage* contracts emerged, now called "public service delegations." In these contracts, the private company became the operator of the facilities owned by the local community: the financing of new investments was borne by the community, while the maintenance and management of existing infrastructure were undertaken by the company. In summary, the French contractual model for water and sanitation services was built through disputes and amendments between cities and the company.

Initially, as explained by Nathalie Dufresne, a former Veolia lawyer, "The first concession contracts consisted of a maximum of fifteen pages, despite committing to long durations of forty, fifty, or sixty years. In essence, it was necessary to finance investments and agree on who paid for what. The water price was fixed, and periodic meetings were scheduled to adapt the contract, and that was it! Nowadays, we sometimes have contracts spanning two hundred pages with a thousand pages of annexes."

The evolving legal framework is based on the three principles of public service established by the courts since the late nineteenth century: continuity (ensuring permanent access to the service), equality (no distinction between users), and mutability (considering that a contract can evolve based on circumstances). It took decades to develop a solid legal framework based on these principles, which was later replicated in all European countries undertaking public-private partnerships. Developed experimentally between the two world wars, affermage became the model contract after 1945, supported by a standard specification set by the Council for Industrial and Commercial Public Services in 1951.

These lengthy legal battles allowed the Compagnie Générale des Eaux to withstand the assertiveness of municipalities and, most importantly, the inflation that emerged after World War I, as invoice prices were not indexed at the time. By shaping the affermage contract, these battles also led to the establishment of a resilient business model that did not bear the direct burden of sometimes significant investments—a "CapEx light" model, as it is known today.

The Company as a Trusted Third Party of the Jacobin State

The state, in turn, asserted its own role by maintaining a balanced position between the two parties involved: municipalities and companies. It even sought, through various means, to limit and minimize the actions of

The Main Types of Contracts Throughout History

What Is a Public Service Delegation?

Public service delegation involves a municipality, department, or region outsourcing the management of a public service, such as drinking water or waste collection, to a private company. The decision to outsource may stem from the technical complexity of the activity, the lack of material and human resources available to the local authority, or the desire to protect the authority from the financial risks associated with operating the service. However, the public entity retains decision-making power and control over the service, as the private operator is required to report on its technical and financial management. Three types of management are distinguished in public service delegation, defined in part by the degree of autonomy granted to the concessionaire operating the service. In order of decreasing autonomy: concession, lease, and interested management.

Concession Contract

In this type of contract, the company must not only manage the service but also finance and carry out the necessary investments for its operation and maintenance. The delegate finances, builds, and operates the public service at their own risk. The activity is therefore entirely outsourced. In return, the company is remunerated based on the service's operating revenues.

- CGE's initial contracts were concession contracts.

Lease Contract

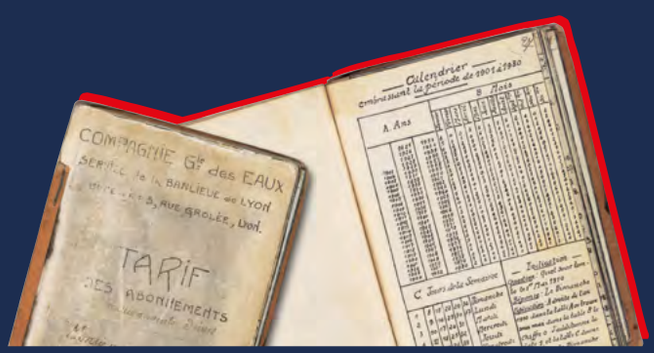
This is an agreement between a local authority, known as the "grantor," and a private entity, known as the "lessee." In this contract, the grantor provides the lessee with the necessary equipment for operating the delegated service. The lessee is solely responsible for operating the service, although the contract may stipulate that certain maintenance or renovation works are the responsibility of others. In return, they are allowed to collect the service's operating revenues but are required to contribute to the public entity in exchange for its provision of the infrastructure. Lease agreements are generally shorter in duration than "concessions," in the jurisprudential sense, because there is no need to amortize the cost of significant construction works.

- Lease contracts gained legal recognition in France between the 1920s and 1950s and are now the most common type of contract in the water industry.

Interested Management

This is a mixed delegation mode in which the co-contractor is responsible for operating the service but is remunerated by the local authority, which remains responsible for directing the service. This allows the local authority to retain control while delegating operational management. The co-contractor's remuneration consists of a fixed portion paid by the local authority (a "fee") and a profit-sharing component linked to the operating results. Depending on the level of risk assumed by the concessionaire, interested management may be classified as a "public contract" or a "service concession."

- The contract concluded in Paris in 1860 with Baron Haussmann was an interested management arrangement.



municipalities in the water distribution sector. It was not the municipality as a public entity that was attacked—public interventionism was not only accepted but advocated for. It was the local community, whose rationality was challenged and who had to yield to a rationalizing and modernizing state: municipalities were not seen as progressive entities.[12] It was in the same spirit that the state challenged their capacity to provide certain services and gradually removed them, including social assistance in 1934 and the maintenance of national roads in 1936.

In terms of water, "the state advocated for a rational management of the activity, organized [...] around three key ideas: ensuring budgetary balance in water services management, going beyond the municipal level to rationalize technical choices, and managing the resource globally." Between 1935 and 1939, the state issued a series of decrees to uphold this doctrine by strengthening its control over local public service concessions.

Water networks operate at the local level, with no communication between catchment areas, necessitating the State's reliance on municipalities to achieve its goals and regulate them.

As early as 1935, the state imposed obligations in terms of water quality. While defending the franc and strengthening its financial oversight of municipalities, the state granted itself direct control measures in addition to those held by municipalities in 1937. It required public commercial interests "to balance their revenues and expenses, meaning they must cover their costs solely through the resources generated by water sales." Water tariffs were "subject to prefectural approval," and it allowed "for municipalities and, especially, their concessionaires to request the Minister of the Interior to terminate or revise their agreements if the delegated water services' accounts are consistently unbalanced."

While these provisions have also imposed constraints on companies, it is undeniable that the Jacobin State designates the specialized water management company as a trusted third party in its relationship with municipalities. It relies on their expertise and defined scope to ensure service quality and budgetary control. "Delegating to private operators within a standardized framework offers the state a means to discipline municipalities without confronting them directly."[13]

Through these decisions, the central state has asserted its primacy in territorial development. Paradoxically, this aligns with the nationalization of railways and the creation of the SNCF (the French National Railway Corporation) during the heart of the 1930s. Both approaches respect each network's specificities and the models they organize: the railway's aim is to create a national network, hence the relevance of nationalization for the state; water networks operate at the local level, with no communication between catchment areas, necessitating the state's reliance on municipalities to achieve its goals and regulate them. Although these approaches seemingly adhere to different economic schools of thought, Marxist or liberal, neither will be questioned outside of political back-and-forth.

A Relationship of Trust to Achieve the Water Miracle

While local authorities were concerned about being custodians of the collective heritage represented by water infrastructure, the Compagnie Générale des Eaux managed to adapt during the interwar period through affermage contracts. While the company's profits decreased, it simultaneously managed to limit its investments. Contracts were then made on an individual basis, *intuitu personae*, a Latin phrase meaning "based on the person." It is from this relationship of trust that the parties could establish the foundations for continuing the contract. In such cases, there was inevitably a "bonus for the outgoing" operator already involved in the game, who could recoup past expenses. The state kept an eye on the situation, transferring "the responsibility for approving concession contracts exceeding thirty years to the Council of State" and leaving "the approval of shorter-term contracts to prefects, to encourage municipalities to sign shorter contracts." The Compagnie Générale des Eaux was particularly renowned for its operational and contractual expertise, prudent management, and understanding of local elected officials' concerns.

Once the affermage system was established and everyone's role clarified, conflicts diminished among the various parties: the private operator acted as an intermediary between the municipality

12 — PEZON Christelle. *Le Service d'eau potable en France de 1850 à 1995*. Paris : CNAM, CEREM, 2000.

13 — *Ibid.*

and subscribers, undertaking tasks such as installing meters and bill collection, while the local community decided on the necessary construction work and managed financing. In the middle, the state financed half of rural water service development during this period (the other half coming from water bills), and it knew it could rely on large private companies to operate the industrial management of the network on the ground. They were, in a way, the armed force for its vision of territorial development. That is why the state promoted affermage contracts when subsidizing municipalities that required infrastructure investments in water services. As a result, according to Christelle Pezon's analysis, "the population served by private operators doubled between 1962 and 1982, from 16.95 million inhabitants to over 33.5 million." In the end, this historical compromise between three parties, each concerned with preserving their prerogatives, allowed France to achieve an efficient organization of its water services. During this period, contracts remained long, and this mixed model even gave many consumers the impression that employees of major private companies were, in essence. civil servants.

To Develop the Entire Territory: Increasing Cooperation

Equipping Suburbs and Rural Areas: Growing Collaboration and Subsidies

While no longer operating in most major cities at the beginning of the twentieth century, the Compagnie Générale des Eaux chose to invest in the suburbs. It thus participated in the incredible growth of the Parisian and Lyonnaise suburbs, which continued to attract new residents to often left-leaning municipalities. These municipalities faced numerous challenges and formed alliances in the form of syndicates. The objective was to entrust their water services to a private company under the benevolent auspices of the state, which was concerned with ensuring essential water services for public hygiene. A new type of contract was implemented: the *régie intéressée* (interested management), initially contracted by the Syndicat des Eaux d'Île-de-France (SEDIF) and later by the Syndicat des Eaux de la Banlieue de Lyon (SIEBL). In this type of contract, small municipalities made investments but were able to share costs, define the work program, and provide service at the best price by pooling their resources.

The Générale des Eaux was particularly renowned for its operational and contractual expertise.

Engineer and researcher Bernard Barraqué has highlighted the ability of companies like CGE to negotiate with such diverse stakeholders. The uniqueness of the French system lies in its network of thirty-six thousand municipalities and an equal number of mayors elected by universal suffrage, with whom one must engage. This requires true expertise, and it is no coincidence that companies like CGE, Lyonnaise, and Saur quickly diversified into transportation and urban sanitation, which are other essential regional services. During that time, the "red belt" around Paris was filled with modest houses built to accommodate the large numbers of employees and workers who were moving in. Communist mayors, as well as priest-builders driven by the social doctrine of the Roman Catholic Church, pressured the government to provide infrastructure such as roads, gas, electricity, sanitation, and water to the suburbs. With the municipal elections of 1935, which saw twenty-six communes fall under the common banner of the French Section of the Workers' International and the French Communist Party, the state was convinced to provide subsidies to contribute to the development of SEDIF municipalities.

After 1945, the same alliance emerged between a planning state and local communities, whose needs were soaring, both in urban areas and in the countryside. It was now unthinkable that everyone did not have access to the modern comfort of tap water, even in the most isolated villages

Aerial view of the water treatment plant in Neuilly-sur-Marne (2008).

in France, although it was clearly "financially foolish in certain rural areas," as noted by Professor Pezon. To make such investments sustainable, it was necessary to pool resources for infrastructure development. "Rural engineers at the time developed water development plans that covered three hundred municipalities at once, for example," explains Pezon. However, none of this would have been possible without the involvement of the Ministry of Agriculture and Fisheries, which predominantly financed the creation of water networks through the FNDAE (National Fund for the Development of Drinking Water Supply), established in 1954. Nearly half of these funds were sourced from a levy on horse racing bets, known as "PMU's share," which remained in effect until 2003. None of this would have been possible without the CGE, which mobilized its expertise throughout the country.

Subsequently, the Compagnie Générale des Eaux managed the distribution of drinking water, often through affermage contracts, in thousands of municipalities, sometimes grouped into communities, following the example set by major suburbs before them. Today, Veolia remains one of the few services truly present in certain hamlets, small town halls, or rural communities, through a permanent presence or a mobile bus during billing periods. The establishment of the FNDAE after the war was also a matter of public health. With agricultural and industrial activities, as well as the emergence of new uses (chemical cleaning products, modern toilets, hygiene products), wastewater began to release increasing amounts of pollutants into rivers and groundwater. It was no longer possible to drink untreated water as was done in rural communities in the past.

To Protect Water Resources, the Organizing State, the Principle of "Polluter Pays," and the CGE All Faced Criticism from Major Corporations

Pollution issues were of such significance that the Pompidou government enacted the first major water law in 1964, the result of extensive work initiated by the Water Commission established by Prime Minister Michel Debré in 1959. [Continued on page 56]

Ivan Chéret

MASTER CRAFTSMAN OF THE WATER LAW

The trajectory of Ivan Chéret may resemble that of many other engineers who, like him, graduated from prestigious schools in the French Republic. However, his story contains more than one unique episode. A key figure in the 1964 Water Law, this former student of École Polytechnique and École des Ponts et Chaussées was born in 1924 to a Russian father who had become a naturalized French citizen, passing on to him the distinct manner of rolling his R's characteristic of those from beyond the Ural Mountains. He never lost this trait, which would have potentially marginalized him at École Polytechnique if not for its liberation from the Vichy regime's xenophobic and anti-Semitic laws. Promoted to École des Ponts et Chaussées in 1944, he truly joined his classmates in 1945. At that time, he already showed a penchant for nonconformity, as he was the only student to accept a scholarship to go to the United States. In an interview, he recalled, "My time in the US in 1949 was completely atypical compared to people my age. I was drawn to everything that was different. My parents were not of French origin. We lived in Marseille during the war, and an English refugee had given me lessons." Following this internship, he traveled to Africa, joining other engineers tempted by developing countries.

Thus he became responsible for the Development Mission of the Senegal River from 1950 to 1953, then the Chief of the Hydraulic District in Bamako, and finally the Deputy Chief of the Hydraulic Service of French West Africa from 1954 to 1958.

His experience in countries facing water scarcity would later shape his vision of water management, which he would partially implement with the 1964 Water Law. This approach emphasized governance at the watershed scale, requiring stakeholders to collaborate in resolving conflicts. He explained years later, "In Senegal, I was able to witness what agriculture is like in a poor country, as well as the complexity of river basin development, not only from a technical standpoint, but especially from a human perspective. Water is used by all human activities, and favoring only one of these activities can greatly harm the others."

In 1959, amidst the decolonization process, Cheret returned to mainland France. The homecoming proved more challenging than expected, but with a few connections maintained in Africa and "a lot of luck," he became the General Reporter of the Water Commission of the Plan and later the Head of the Permanent Secretariat for Water Issues (SPEPE) in 1960. These bodies played a crucial role in shaping the key principles of the renowned Water Law. At the time, the stakes were high, as urgent challenges arose from rapid urbanization: ensuring access to drinking water for all, expanding sanitation networks, and combating pollution. As he recounted during a colloquium in 2011, "The 1960s was a different world. There was industrial, agricultural, and urban development. All of this required water, and everyone was taking it. Everyone needed to discharge waste, and everyone was doing so. Therefore, the law was passed in Parliament to put an end to this."

Negotiations surrounding this law would be fierce, particularly with local elected officials and industrialists who were clearly the targets of certain proposals. Industrial business leaders argued that implementing the law would mean the death of the industry in France. Ivan Chéret quickly engaged in discussions with powerful fishermen's associations, who had significant electoral influence and were directly affected by fluctuations in water quantity

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and quality during the summer. Their lobbying proved invaluable in the battle against the industrialists, who were pushing for the classification of watercourses based on their quality—an approach that implied "sacrificing" some of them. Under the influence of engineers from the Mines, Bridges, and Roadways schools, and with strong support from the Compagnie Générale des Eaux, the 1964 law demonstrated wisdom by relying on financial and economic tools to preserve water resources and encourage industrialists to treat their wastewater. On one hand, the law provided assistance for the construction of wastewater treatment plants; on the other, it established the "polluter pays" principle, whereby a fee was collected by watershed agencies for all polluting activities, which was then used to finance water and aquatic environmental protection operations in the six major watersheds identified by experts.

In 1966, just two years after the promulgation of the law, Ivan Chéret was tasked with making his idea of watershed agencies a reality, drawing inspiration from the German experience in the Ruhr region, where cooperative unions oversaw water-related developments necessary for the watershed's equilibrium.

In a collective work on the fiftieth anniversary of the law, Bernard Drobenko and Jérôme Fromageau provide a positive assessment of its effects: "This law, highly innovative for its time, enabled France to play an exemplary international role in the field of water resource management. Its influence spread worldwide and notably, in the year 2000, inspired the content of the European directive establishing a framework for community policy."

Ivan Chéret concluded his duties at SPEPE in 1970 to become the Director of Gas, Electricity, and Coal at the Ministry of Industry until 1973. He then served as the Chairman and CEO of SITA (the International Aeronautical Telecommunications Union), specializing in waste transportation and valorization, for over ten years before returning to the water sector as the Director of Water at Lyonnaise des Eaux from 1983 to 1989—a competitor of the Compagnie Générale des Eaux, later renamed Suez. In 1990, Ivan Chéret advocated for the creation of a new organization, the future International Water Office (OiEau), of which he assumed the vice presidency. As a visionary, he wrote an article for the Revue des Deux Mondes at that time, stating, "Drought and pollution are intertwined and remain the two dominant themes in current affairs at the beginning of this decade. It is urgent to identify water resource management issues and protect them from pollution. The measures to be taken are primarily of a political nature."

While climate change was still a subject of controversy, Ivan Chéret was already alerting public opinion to the availability of water resources, particularly during peak consumption periods, and its impact on quality. He advocated for the reuse of treated wastewater and called on public authorities to make firm decisions when arbitrating between different users—all topics whose significant importance we are rediscovering today ●

The new law represented an administrative revolution. In a highly centralized country where the state is strongly present and covers the territory with its network of prefectures and sub-prefectures, the law laid the "foundations for decentralized management," as emphasized by Hervé Paillard, Director of the Process and Industrialization Department at Veolia. Six major hydrographic basins were established to organize a "comprehensive water management." Water agencies were created to oversee these six basins, becoming operational in 1972. And beginning in 1992, the state implemented a six-year planning tool known as SDAGE (Directives for Water Management and Planning).

As early as 1990, Prime Minister Michel Rocard aimed to put water policy on the agenda, having "always shown a keen interest in public water management policies, following an inspection mission of water agencies that he coordinated while working at the Inspectorate of Finance."[14]

The 1964 law also marked a revolution in terms of economic responsibility, with the first application of the "polluter pays" principle. The model was doubly incentivizing, as taxes were levied on polluting activities on one hand, while subsidies were granted for sanitation work on the other. The 1964 law also established a water "police force" with four types of mission: construction on watercourses, water withdrawals, sanitation, and drinking water. According to Veolia's President Antoine Frérot, "The 1964 law created an institutional framework that mandated water sanitation and provided funding to accomplish it. Companies in the sector realized that there were opportunities for diversification beyond drinking water. This created the second aspect of the water business, which includes wastewater treatment and sanitation." With this impetus, France had equipped itself with thousands of wastewater treatment plants in both urban and rural areas within a few years.

The Compagnie Générale des Eaux paid a price for its active support of the adoption of this law, as it was ostracized by the French employers' organization, CNPF (the National Council of the French Employers), the predecessor of MEDEF (the Movement of the Enterprises of France), until 2005. "And even then, only as an observer, which lasted for another five years," adds Frérot. This is a testament to Veolia's unique vision and status within the French business landscape, being both integrated into the market economy and a promoter of new regulations.

The French Model: International Development

The 1980s and 1990s witnessed the maturation of the French model, which continued to adapt. In order to enhance competitive dialogue between local authorities and companies and eliminate collision risks, the state, through the Sapin 1 law of 1993, put an end to individual contracts and introduced mandatory competitive bidding procedures and limitations on contract duration for water and other sectors. Above all, France was ready to set an example.

French companies had developed unique human and technical expertise. The contractual model of delegated management had proven effective in modernizing the country, and now an institutional and financial framework was established to encourage responsible resource management. These three elements formed the foundation for what companies, recognizing it as a "development argument"[15] according to water policy and technical expert Jean-Luc Trancart, began to literally refer to as the "French water school."

The world was changing, becoming more globalized and presenting new opportunities

The first major water law enacted in 1964 created an institutional framework that mandated water sanitation.

14 — TRUCHOT Claude. « La loi sur Water du 3 janvier 1992 a 20 ans ». *Pour mémoire, no. 11 (Summer 2012).*

15 — TRANCART Jean-Luc. « L'avenir de l'École Française de Water ». *MINES Revue des Ingénieurs*, no. 458 (January/February 2012).

for environmental services development. It started with the privatization movement initiated by Margaret Thatcher in the United Kingdom in 1983, followed by economic liberalization in Latin America, and continued with development support projects in African countries, the fall of the Berlin Wall in 1989, and the economic boom in China.

French companies were ready to seize their chance. American companies, which attempted to develop on a different model, failed. National contexts observed in other European countries also did not allow for the emergence of major champions. In France, "we were ready to compete when the market began to exist, and we were the only ones," summarized Antoine Frérot.

To be sure, the Compagnie Générale des Eaux was not the first to venture into international competition. The company's management teams still remembered its initial failed attempts and believed that local and national dimensions were more important, preventing any long-term hopes of internationalization. It is true that the previous developments abroad, starting from 1879, initially generated a great deal of optimism—symbolized by the inauguration of the water service in Venice, which, after an extraordinary construction project involving the installation of underwater pipelines in the lagoon and the deployment of a distribution network between the islands of the Serenissima, became a popular celebration in St. Mark's Square. However, in practice, these developments proved risky. The company faced geopolitical uncertainties and, being perceived as a foreign entity, experienced expropriation and confiscation of revenues, resulting in significant losses overseas, particularly after World War I.

Therefore, it was Lyonnaise des Eaux that first obtained contracts in Great Britain, Buenos Aires, Manila, Jakarta, and other places. Ten years later, however, this

Water pumping station of Ivry / Farco installations, machine building, 1900.

internationalization effort had resulted in numerous failures, underscoring the importance of precise governance modes.

"Our luck was that we missed being the first ones to go," acknowledged Antoine Frérot. Armed with this knowledge, the company embarked on its own mission. "To conquer international markets, we do two things," said Frérot. "We send French people, often engineers, on missions to the country, and we theorize the French model, adapting it to local specificities."

It wasn't always obvious: "When I was first sent abroad, I wondered if it was a punishment," recalled Philippe Guitard, who has since become the director of a large Central and Eastern European zone. But today, "the fact that we invented this model still resonates strongly in the United States," says Frédéric Van Heems, CEO of the North American zone for Veolia.

In Central and Eastern Europe, as well as Africa, the World Bank and the EBRD (European Bank for Reconstruction and Development) "adopted the water model and promoted it," Frérot recalled. Just as the French State did in the 1930s, these institutions saw French companies as trusted partners for mobilizing technical expertise and making the best use of public financing dedicated to development.

The European Union set environmental conditions for the integration of Eastern European countries and required them to provide a worthy, reliable public water service capable of treating pollution. These constraints led to calls for tenders for water and sanitation service management in Central European cities like Prague, Budapest, Bucharest, Sofia, Warsaw, and Yerevan. "We were present in Prague in 2003, before the integration of the Czech Republic into the European Union in 2004," said Frérot.

The term "French water school" is particularly fitting within the European Union. The EU's Water Framework Directive in 2000 faithfully captured the principles of the 1964 law and further deepened them to improve the quality of European watercourses, thereby increasing the level of environmental standards for all European countries and the market potential for companies in the sector.

China, while experiencing rapid development, also opened its doors to French companies and chose delegated management for its cities and industries. Its desire to collaborate with national partners aligned well with the convictions formed within the company.

This dynamic, after the pioneering phase, accelerated in the 2000s under the leadership of Antoine Frérot, who made the decision to integrate countries geographically rather than organizing the group, now renamed Veolia, based on its business lines. This approach prioritized local presence. In the water sector alone, the share of delegated public service contracts increased from 2 percent in 2000 to 10 percent in the early 2020s. By integrating Suez's international activities,

"We were present in Prague in 2003, before the integration of the Czech Republic into the European Union in 2004".

Antoine Frérot

Wastewater treatment plant, Budapest.

the revenue generated by the group's international operations reached nearly 80 percent by 2023.

The French water management model was reinforced in theoretical terms in 2009 by Elinor Ostrom, the first female Nobel laureate in economics. According to Ostrom, in the governance of "commons," a choice between the market and state regulation was not sufficient. Given the multiple challenges around them, she emphasized the need to seek a third way involving all stakeholders in a polycentric system better suited to the circumstances.

Looking to the future, France may benefit from enriching its model with those developed elsewhere. With the EU Water Directive, "new challenges have emerged," explains Jean-Luc Trancart. These include the biodiversity of aquatic environments, river rehabilitation, and heritage protection of water resources. The question is: which institutional, economic, and industrial actors should be mobilized to consider these silent and insolvent users, including aquatic environments and future generations? In the Netherlands, for example, sanitation and water maintenance are funded through property taxes, while in England, 75 percent of water bills are based on the rental value of the property.[16] Veolia, now experiencing these different national specificities, will continue to contribute to the discussion on shaping these new models ●

16 — *Ibid.*

From the First Paid Leave to the Veolia Cares Program: A Social Tradition at the Heart of the Model

Paid leave is generally attributed to the Popular Front, but "there were paid leaves before 1936 in France," says historian Pascal Ory.[1] The first paid leave was initially granted to civil servants, who have been entitled to fifteen days of paid leave since 1853—coincidentally, the same year the CGE (General Confederation of Employees) was founded—following another imperial decree by Napoleon III. "The civil service was the first, from the nineteenth century, and it would be cherished by successive governments, including the authoritarian governments of the Second Empire. It was necessary to ensure the loyalty of civil servants by guaranteeing them conditions that were far superior to those in the private sector. The novelty of 1936 was the generalization."[2]

By extension, some private sectors have also benefited from paid leave since the early twentieth century, such as employees of the Paris metro, electricity companies, gas factories, and book workers, who gained the same right to rest and leisure. The Compagnie Générale des Eaux (CGE) was part of this movement. Long before the Popular Front of 1936, the company's staff regulations provided for paid leave and even retirement for its employees. Despite facing competition from public management from the beginning, CGE demonstrated that "industrial efficiency is compatible with a political project when it comes to water and sanitation public services."[3]

Continuously driven by this conviction, CGE (later Veolia) developed a social policy that paid close attention to the employees of the group, their training, professional and social mobility, work engagement, and their rights. Given that its activities require a significant amount of labor and that operational training for its professions is not always available on the market, Veolia's proactive training policy is one of its distinguishing features. In France, this investment was demonstrated as early as 1994 with the establishment of Veolia campuses in partnership with local authorities and employment and training agencies. "At the time, it was a true originality," says Jean-Marie Lambert, former Deputy General Manager of Veolia in charge of human resources. "It allowed the creation of new professions in transportation and sanitation, initially, and then in water and energy. During those years, even the group's seminars with executives took place on these campuses in Jouy-le-Moutier, Tarbes, or Lyon... Executives were seated alongside apprentices, for example. Symbolically, it was powerful."

Today, the campuses have disappeared, but their legacy persists. "I would say that we inherited three axes from these campuses," Lambert concludes. "The primacy of apprenticeships and learning in training, professional progression, and the unity of the group, because at the time there were many different divisions. Since the 2000s, there has been one Veolia per country."

More generally, attention is always paid to meeting the needs of each region. Moreover, while studies[4] demonstrate that the highly qualified are often given preferential access to training, Veolia strives to enable those with fewer qualifications to train and progress in their professions. Over 80 percent of training efforts are dedicated to operators and technicians, and certification courses have been created to promote upward mobility within the company. "Ecological transformation, which is also linked to digital transformation, will impact employment, particularly for new entrants to the job market and low-skilled occupations," says Olivier Carlat, Director of Social Development at Veolia. He believes it is important to make ecological transformation "an opportunity for social transformation."

Learning and apprenticeship programs have also been developed since the early 2010s, under the impetus of Antoine Frérot, to promote the future employment of all individuals. Furthermore, with an even broader ambition, the School of Ecological Transformation has been under construction since 2022. "We have a responsibility to train and raise awareness not only among our employees but also, as a leader, among all our stakeholders about

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ecological transformation," says Laurent Obadia, Deputy General Manager in charge of stakeholders, communication, and the Africa Middle East region. "That's why we will be offering them numerous training courses, open to everyone: executives, employees, professionals in career transition, and students in initial training, right at the heart of each region." Sometimes, it is the teams abroad that initiate fruitful social dialogue. "There are dynamic countries in terms of human resources," notes Lambert. "In South America or Morocco, for example, they are responsive to professional advancement and anything related to society. It encouraged us to compile a collection of social initiatives, with a jury that awarded prizes to the most deserving. It highlighted the integration of people in difficulty, actions of solidarity, and valued employees."

Veolia also embraces new managerial approaches to further empower each employee. "We provide a proximity service, twenty-four seven, and for our clients, Veolia is primarily the local manager," explains Frédéric van Heems, CEO of North America. "We must constantly seek to ensure that, with their teams, they feel supported and responsible: that's how they will give their best."

Estelle Brachlianoff, CEO of Veolia, also insists that Veolia's social model does not stop at the borders of France but extends to all employees in countries where the company operates, even where the law does not require it. Protections include parental leave with a minimum of ten weeks, health coverage, death coverage with a provident system guaranteeing a minimum of six months of family benefits, support for "caregiver" employees taking care of seriously ill loved ones, and voluntary work allowing each employee to devote one day per year to an association during working hours. Formalized in the Care program, these benefits accompany employees in key moments of their lives and are intended to apply everywhere and to everyone.

"In addition to fighting against geographical or status inequalities in terms of social benefits, this program promotes diversity, which is essential for the group's development," says Isabelle Calvez, Director of Human Resources at Veolia. "It also enhances its attractiveness for those who wish to find meaning in their professional activities while benefiting from a social model that fosters their fulfillment." ●

1 — Pascal Ory, interview by Philippe Collin, Ep. 5: "1936, changer la vie", *Léon Blum, une vie héroïque*, podcast, Radio France.

2 — *Ibid.*

3 — TRANCART, Jean-Luc, professor of water policies and techniques at Ecole Ponts et Chaussées. "L'avenir de l'École Française de l'Eau".

4 — "Les inégalités d'accès à la formation professionnelle", French Observatory of inequalities, May 2019.

CHINA

Opening the Chinese Market: Public-Private Partnership (PPP) Opportunities for Foreign Companies

In the early 2000s, China emerged as the fourth largest economic power in terms of trade, continuing the strong economic growth that began twenty years earlier. While the Chinese government, keen on controlling its transition to a market economy, implemented a policy of gradual opening in the early 1980s, the opening intensified in the early 2000s with the "open door" policy, inviting foreign companies to establish themselves in the country.

It is in this context that Veolia signed a fifty-year contract in 2002 with the city of Shanghai to operate the water supply in the Pudong business district. It became the first foreign company authorized to provide water supply services in the country through a public-private partnership (PPP). Its mission was to ensure water security for the Pudong region and major events held in Shanghai, such as the 2010 World Expo. Over the past twenty years, the service area has significantly expanded, while the length of the network has more than doubled.

This contract was just the beginning of a long history of public-private partnerships between the French company and China, as Veolia won two more public service delegation contracts a little over a year later: one for a fifty-year period with the city of Shenzhen for the production and distribution of drinking water, and another for a twenty-year operation of the Lugouqiao wastewater treatment plant located in the western part of the Beijing metropolitan area—with a focus on the 2008 Olympic Games. Building on the success of the Pudong project, Veolia has since ventured into other water concessions in Changzhou, Kunming, Tianjin, and Haikou ●

JAPAN

The Waterworks Amendment Act in Japan: The Beginning of a Long History between Japanese Local Authorities and Private Companies

In 2002, the Waterworks Amendment Act was passed in Japan. Japanese local authorities were now able to delegate the management of their public water services to private companies. Veolia, which had anticipated this law and prepared for it for several months, had established its presence in the archipelago a little earlier.

While local authorities were organizing the implementation of public service delegations, Veolia won the contract in 2006 for the operation of the Hiroshima wastewater treatment plant, one of the largest projects ever delegated by a Japanese municipality under an operating and maintenance contract.

In 2012, the company also won the contract for the operation and maintenance, for a period of five years, of all the drinking water plants serving the city of Matsuyama, located in the south of the archipelago on the island of Shikoku. Since then, in addition to being the only non-Japanese group operating in Japan's wastewater market, Veolia is now also the sole foreign participant in the drinking water market.

Four years later, Veolia expanded its activities in the energy sector with the operation of two biomass power plants before becoming involved in waste management, thus supporting the development of a circular economy and decarbonization in Japan ●

Story
3

Sanitation and Treatment

A New Frontier for Health

Initially, the companies that brought running water into homes did not foresee the need to handle sanitation. It was only later that they had to take on this responsibility. Specifically, with the end of water scarcity—a period in which water resources had been more about prestige and power than comfort and service—and the advent of the modern era, the volume of contaminated water multiplied significantly.

However, due to limited resources and political necessity, French cities were long reluctant to invest in sanitation. In 1909, only 10 percent of French cities with a population of over five thousand had implemented a comprehensive sewer system, compared to 36 percent of their German counterparts. Private companies stepped in to provide this service, contributing to a unified and fair development of France's territory •

GRÉGORY QUENET

British economist Angus Deaton, who was awarded the Nobel Prize in Economics in 2015, highlights sanitation as a key element in the "great escape" of humanity, alongside advances in nutrition and growth. By increasing life expectancy, "not only will almost all newborns survive to adulthood, but each young adult has more time to develop their talents, passions, and life, leading to a significant increase in skills and well-being."[17] This "great escape" is much more engaging than the one depicted in Jean Giono's novel, where a soldier seeks refuge on rooftops to escape cholera.[18] The Saint-Simonian disciples of Prosper Enfantin could not have hoped for a more dazzling success.

However, they did not have all the keys to meet this challenge in 1853. The supply of water from outside the cities was not immediately accompanied by controlled wastewater disposal. Moreover, the development of networks initially neglected the treatment of water pollution, both upstream and downstream of its consumption. While ancient treatment techniques did exist, it took numerous innovations and significant financial resources to ensure the long-term health of populations and the increase in life expectancy.

How did territories address the challenge of transforming unsanitary water into safe, drinkable water? How did scientists find ways to sanitize wastewater discharged into the natural environment? With industrial, agricultural, and domestic effluents, as well as the impact of climate change on water pollution, what progress has been made in terms of treatment? Let's take a closer look at these advancements, made possible by generations of chemists and biologists ●

The Beginnings of Water Purification and Treatment

With over seventy quality criteria, both sanitary and environmental, tap water has become one of the most regulated food products in France. However, the concepts of "potability" and "sanitation" vary depending on the era and scientific knowledge. Originally, "potable" water was directly drawn from rivers or underground aquifers without any further intervention. However, several millennia before Christ, people realized that turbid or odorous water could be unpleasant. "The concept of water quality and treatment has been known for a long time. The Egyptians used aluminum salts, alum, for coagulation, which was used for water treatment," explains Philippe Hartemann, professor of public health at the University of Nancy.

The Middle Ages marked a period of regression in terms of water treatment. No major innovations in water treatment would appear for nearly a thousand years. On the contrary, wastewater and waste were directly discarded into the streets, contaminating sources of drinking water through runoff and infiltration. According to the National Library of France, the first mention of a sewer that was not open-air in Paris dates to 1325. It was a gallery that passed under the City Hall and drained into the Seine. This dark period, which sometimes receives exaggerated discredit, contributed to shaping the unsanitary conditions of cities. However, it came to an end thanks to the development of science and a major discovery in 1670: the microscope.

From that point on, research rapidly advanced, as the microscope allowed

17 — DEATON, Angus. "La Grande Évasion. Santé, richesse et origine des inégalités". *Idées économiques et sociales*, no. 187 (March 2017).

18 — GIONO, Jean. *The Horseman on the Roof*. New York: Alfred A. Knopf, 1954.

scientists to observe tiny particles in water. Throughout the eighteenth century, water filters made of sponge, wool, or charcoal became more common in households. During the same period, wealthy landowners used large burnt wood tanks to store water in better conditions.

In the Mid-nineteenth Century, Circulation before Purification

It was through the building of circulating networks that the hygienic revolution first took place. The health movement, which began in the late eighteenth century, gained importance in 1832 during the first cholera epidemic in Paris. The severity of the disease, which killed thirty thousand people in Paris and one hundred thousand throughout the country, highlighted the importance of city sanitation. At that time, scientists adhered to the theory of miasma, which suggested that diseases were transmitted between individuals through a toxic vapor filled with particles. The first step was thus to create movement, and that's where the network came into play. As analyzed by Alain Corbin, according to their conceptions, "the model of the circulatory system, in an organic perspective, implies the imperative of air, water, and product movement. The opposite of 'unsanitary' is 'movement.' [...] The virtue of movement encourages channeling and the expulsion of filth. [...] Draining the city through sewers is disarming the putrid ancestral stagnation, preserving the future of the city, and ensuring, through technology, the regulation that nature alone cannot achieve in these artificially crowded places."[19]

The discoveries made by British physician John Snow in London, although vigorously contested by the scientific community when he presented them,

19 — CORBIN, Alain. *The Foul and the Fragrant: Odor and the French Social Imagination*. Leamington Spa: Berg, 1986.

Flow meter (Glenelg Sewers Department).

further emphasized the importance of a clean water supply. It was Snow who demonstrated the transmission of cholera through contaminated water during the 1854 London epidemic, rather than through polluted air. “He noticed that there were more sick people on one side of the street than the other. Through his epidemiological study, he demonstrated that the sick individuals had fetched water from a contaminated fountain. Once access to that fountain was prohibited, the epidemic disappeared,” recalls Philippe Hartemann. These discoveries encouraged cities to seek water sources other than their own wells.

In Paris, a strategy of diversifying water resources was being implemented in order to improve the quality of the drinking water. “Initially, we were seeking water from further or deeper sources to ensure its purity,” explains Séverine Dinghem, Director of Support for Professions and Performance at Veolia. To address the challenge of resource diversification, Baron Haussmann initiated the construction of aqueducts that would supply Paris with water from the sources of Le Havre or directly from the Dhuys. Water treatment was not considered the best way to obtain high-quality water. On the contrary: “At the time, Haussmann and his director of water services, Belgrand, made it a political objective to supply Paris with naturally pure and fresh water,” says Paul-Louis Girardot, former CEO and administrator of CGE. During the 1867 Universal Exposition, in the competition between Napoleon III and Queen Victoria, Haussmann and Belgrand demonstrated a renewed French superiority. To ensure this objective in the long term, Haussmann planned to extract water from the alluviums of the Loire and transport it to Paris by gravity.

In contrast, Bernard Barraqué, CNRS research director and water specialist, points out that the city of Lyon chose to draw water from its rivers or groundwater, emphasizing proximity. The Saint-Clair plant, operated by the Compagnie Générale des Eaux for the city of Lyon, treated water from the Rhône by naturally filtering it into two large underground basins.

Sewer gallery in Germany.

The management of wastewater also became a major concern in the French capital, where “the quality and collection of wastewater quickly became an issue to prevent contamination of drinking water distribution points,” says Dinghem. Moreover, as water consumption increased, the quantity of contaminated water also increased. To address public health needs, the first sanitation networks emerged in Paris during Haussmann’s major projects, thanks to the ingenious sewage system devised by Eugène Belgrand.

Haussmann, an engineer from the Corps of Bridges and Roads, transformed Paris by creating a unified double underground network: one supplied drinking water while the other eliminated wastewater through the sewers. Belgrand’s objective for the sewer system was multifaceted: to evacuate rainwater, industrial waste, and household wastewater, and to enable cleaning of the galleries using valve

wagons. Under each Parisian street, he coordinated the installation of a sewer. In total, the engineer constructed six hundred kilometers of sewers beneath the feet of Parisians. "What makes the Parisian network unique is its visitability. Thanks to this, even today, we can visually diagnose and locate a leak in the majority of the network at a low cost by conducting an inspection or even sending a drone," says Dinghem.

In a less monumental manner, the Compagnie Générale des Eaux also developed its expertise and signed its first contract with Boulogne-sur-Mer in 1880, incorporating the management of wastewater. "Indeed, it planned for the construction of a sewer network, taking charge of the evacuation of wastewater and fecal matter that, until then, were discharged [...] into the front port and the grounding port," historian Patrick de Gmeline writes.[20] It constructed sixteen kilometers of sewers to complement the city's infrastructure.

At the end of the nineteenth century, the correlation between disease and water contaminated with microbes was scientifically demonstrated.

The modern sanitation network that we know today naturally took time to emerge, but it took a major step forward from 1894 with the law that made sewerage mandatory.

Between Public Health Crises and Scientific Discoveries: The Beginnings of Modern Treatment

Initially, water networks were intended to fetch clear water in large quantities from outside cities, while sanitation networks aimed to dispose of putrefying water far away. In line with miasma theories, they merely created movement to prevent stagnation, ultimately expanding the circle of pollution identified by John Snow. At its inception, "the sanitary movement had no science to guide its efforts," emphasizes Deaton.[21]

However, a scientific revolution emerged at the end of the nineteenth century, accelerating awareness of the need to treat the resource. Gradually, the miasma theory gave way to the microbial theory. The epidemiological work of the British John Snow was succeeded by the Germans Robert Koch and Karl Joseph Eberth, who laid the foundations of microbiology, and then by the Frenchman Louis Pasteur, who became one of its most famous figures. Thanks to them, we can now say that "not everything that stinks is deadly, and not everything that is deadly stinks," says Corbin.[22] The correlation between disease and water contaminated with microbes was scientifically demonstrated. "We drink 90 percent of our illnesses," Pasteur declared in 1881.

These discoveries helped to understand the lingering health problems associated with the creation of networks and to provide solutions through the implementation of treatment methods. "Science eventually caught up with practice, and the microbial theory of disease was gradually put into application through more targeted measures based on scientific grounds." The history of modern treatment begins after the history of networks. However, as Deaton observes, "transitioning from the microbial theory to safe sanitation and water takes time and requires money and authority." It also requires "engineering and monitoring skills to ensure that the water is truly uncontaminated."[23]

Treating the Water We Drink: From New Techniques to Strengthened Surveillance

To ensure that the water reaching the taps of the French people is of the highest possible quality, drinking water treatment plants, particularly those operated by engineers from the Compagnie Générale des Eaux, initially equipped themselves with slow sand filtration systems. These systems first removed the turbidity of the water,

20 — DE GMELINE, Patrick. *Compagnie Générale des Eaux : 1853-1959, De Napoléon III à la Vᵉ République*. Paris: Ed. de Venise, 2006.

21 — DEATON, Angus. "La Grande Évasion. Santé, richesse et origine des inégalités". *Idées économiques et sociales*, no. 187 (March 2017).

22 — CORBIN, Alain. *The Foul and the Fragrant: Odor and the French Social Imagination*. Leamington Spa: Berg, 1986.

23 — DEATON, Angus. "La Grande Évasion. Santé, richesse et origine des inégalités". *Idées économiques et sociales*, no. 187 (March 2017).

Louis Pasteur

FATHER OF MICROBIOLOGY AND PIONEER OF THE HYGIENIC MOVEMENT

Louis Pasteur has left an indelible legacy in various fields of research, including public health and the role of water in hygiene. The chemist—and physicist-by-training—contributed to the collective awareness that water could contain microbes and transmit diseases.

In the collective imagination, Louis Pasteur is known for his intelligent eyes, gazing intently into the camera lens of Félix Nadar. He is also hailed as the father of modern medicine, the inventor of the rabies vaccine, and the namesake of the pasteurization process that extends the shelf life of our food and beverages. However, how many are aware of his pivotal role in ensuring the safety of the water we consume?

Born on December 27, 1822, in Dole, in the Jura region of France, Pasteur was admitted to the École Normale (an elite French school) at the age of twenty-one, where he studied physics and physical chemistry. In 1847, he defended his doctoral dissertation in science at the Faculty of Sciences in Paris. Ten years later, he was appointed as the administrator in charge of studies at the École Normale Supérieure.

From biology to agriculture and medicine to hygiene, Pasteur distinguished himself in numerous fields and pushed the boundaries of scientific knowledge of his time, laying the foundations for our current understanding of germs and their role in disease. He dedicated a significant part of his career to studying waterborne illnesses caused by contaminated water and lack of sanitation, notably cholera.

Pasteur is remembered for his demonstration of the existence of microbes, which develop, among other places, in aquatic environments. After memorable battles against his opponents, particularly Félix Pouchet, a renowned biologist and staunch defender of spontaneous generation, Louis Pasteur published his work refuting this theory in 1861 and 1862. According to him, microorganisms present in atmospheric dust develop and multiply; no living being emerges from nothingness. Furthermore, these microbes can cause diseases and contaminate entire populations. Hence, they should be avoided and combated. In doing so, Louis Pasteur contributed to the hygienic movement by emphasizing the importance of cleanliness, especially hand hygiene, and the role that water supply plays in combating diseases. Providing the evidence needed for the triumph of the microbial theory over the miasma theory, he also stated that water can carry diseases without being visible or detectable, and may require treatment to eliminate them.

By closely studying the life of microorganisms, he also laid the groundwork for early treatments, highlighting the role that filters or microorganisms themselves can play in self-consumption or annihilation—as seen in the principle of activated sludge, particularly used in wastewater treatment plants. Pasteur's discoveries, like his predecessors', were not the result of spontaneous generation of ideas in the fertile mind of a genius; they were the fruit of experimentation, not without errors, and built upon a long series of scientific progress.

Pasteur's breakthrough in developing the rabies vaccine in 1885 brought him worldwide acclaim, and he received numerous honors. The Academy of Sciences proposed the creation of an institution dedicated to treating rabies, leading to the establishment of the Pasteur Institute in 1888. Pasteur passed away on September 28 in Villeneuve-l'Étang, in an annex of the Institute that bears his name. He left behind a profound transformation in our relationship with water, summed up in the apocryphal quote, "We drink 90 percent of our illnesses." ●

which gives it its color. They were gradually complemented by sedimentation and coagulation devices, which settle particles and make them sink to the bottom of basins before the water passes through filters, significantly improving the quality of the distributed water.

In Germany, Koch installed large sand filters to supply Hamburg with water, thus putting an end to a cholera epidemic. Thanks to the work of Louis Pasteur in the late nineteenth century, filters were able to better eliminate microbes. This applies to the Pasteur filter, named for Louis Pasteur but conceived by French biologist and physicist Chamberland. Equipped with a porcelain cylinder, it filters liquids and can retain the microorganisms in the water. Engineers and leaders of the Compagnie Générale des Eaux are attentive to the numerous scientific developments and support initiatives aimed at increasing water treatment capacity in France. “After studying the filtration methods used in Germany and England, they concluded that they were not sufficient to obtain high-quality drinking water. They favored the coagulation method, known as the ‘Anderson’ process, based on iron,” narrates Patrick Gmeline.[24]

Dedicated water treatment plants multiplied, further transforming our relationship with water. It changed from being a natural resource within reach to a resource that is transported across distances, increasingly resembling a good that requires human intervention and transformation. In the capital, where water quality remained unstable, “the Compagnie Générale des Eaux was called upon to contribute to the improvement of the purity of Parisian water.” The Choisy-le-Roi plant, built in 1861, had slow sand filters from the 1890s onwards, a first of its kind in France. Extensive work was “undertaken by the Company in the Méry-sur-Oise and Neuilly-sur-Marne stations,” and the first experiments on new filtration systems were conducted at the Boulogne-sur-Seine plant.

However, this was not enough. “In 1892, Paris and its suburbs were once again severely affected by cholera, which killed 1,800 people. Upstream of the capital, where the river water was relatively pure, cholera caused minimal casualties. Downstream of the sewer outlets, the mortality rate was much higher.” Two consequences followed. The first involved revising the general distribution scheme, which stipulated that the Company “consolidate its filtering plants upstream of the Seine” in Choisy-le-Roi. The second focused directly on the quality of the water produced, “drawn from areas known to be clean” and especially “purified by iron treatment followed by sand filtration.”[25]

24 — DE GMELINE Patrick. *Compagnie Générale des Eaux : 1853-1959, De Napoléon III à la Ve République.* Paris : Ed. de Venise, 2006.

25 — *Ibid.*

Photo of a Chamberland filter.

In the early 1900s, physico-chemical treatments of water using ozone, ultraviolet light, or chlorine complemented the water filtration process with disinfection. These discoveries coincided with the Public Health Act of 1902, which, for the first time, obliged municipalities to comply with a number of water quality criteria. “Hygienists included the search for indicators of fecal contamination in the regulations. When they were found in the water, it was classified as a risk for human consumption,” explains Professor Philippe Hartemann.

Nice played a unique role in developing the first of these new treatments: ozone. Both in Nice and Paris, the quality of water delivered through the networks was unsatisfactory. A local chemist, Marius-Paul Otto, relied on the Dutchman Martin Van Marum’s discovery in 1781 of how to artificially create this gas made up of three oxygen molecules, and on its bactericidal properties, discovered by the German Ohlmüller in 1891, to improve water treatment. “The principle was simple: by producing ozone through electricity, one could greatly reduce the number of microbes and organic matter in the water [...]. However, to make the process usable on a large scale, industrial production of ozone would be necessary,” Gmeline writes.[26] Otto achieved this.

Although the Compagnie Générale des Eaux was interested in Otto’s work, it initially remained cautious about this innovation and refused to commit to it financially—unlike what would happen later when they integrated the Compagnie Générale de l’Ozone, created by Otto, into their organization. However, progress was made on the operational front. The municipal council of Nice gave the Compagnie Générale de l’Ozone “the green light to implement its ozone process” at the Bon Voyage site, operated by CGE, in 1905. The ozone unit, the first of its kind, was put into operation in 1907. Two more units followed immediately in Nice and throughout the region. In just a few years, it was “considered everywhere as having the healthiest water in France.”[27] The process would later be replicated throughout the country and abroad.

Beyond technical treatments, the importance of surveillance was emphasized by the typhoid fever outbreak that occurred in Lyon in 1928. The toll was heavy, with over three hundred deaths. “The cause was an aqueduct built by PLM, located between two collection wells, which over the years became a sewer into which the residual water from numerous villas in Vassieux, near the company’s factory of the same name, was discharged.” Measures were taken, such as enhanced protection of the collection areas. However, to strengthen the quality of surveillance, “the establishment of a laboratory dedicated to the bacteriological quality of water” was implemented.[28]

Water Treatment of Discharged Water: From Spreading to Wastewater Treatment Facilities

The link between improving the quality of consumed water and that of the water being discharged was quickly established. In Paris, where Eugène Belgrand designed the system, wastewater was initially evacuated to two sites located in Asnières and Clichy, in the near suburbs of Paris. However, the 400,000 cubic meters of polluted water discharged into the Seine River each day created significant pollution. Eugène Belgrand then opted for an alternative solution: spreading. This idea was inspired by existing practices, as septic tank emptiers often resold the product of their purges as fertilizer.

“We realized that discharging wastewater into watercourses was not the right option, because even though they have a self-purification capacity, they only eliminate contaminants when they are present in a certain quantity. Discharging wastewater outside the cities was not sufficient; it needed to be treated when there was too much of it. In Paris, this began with the discharge of wastewater into fields,” explains Sophie Besnault, research engineer at the National Research Institute for Agriculture, Food, and the Environment (INRAE). The attempt was made to infiltrate wastewater into the soil of the Gennevilliers plain. “This was a preliminary treatment stage because we reused the nutrients[...] [Continued on page 76]

The Public Health Act of 1902 obliged, for the very first time, municipalities to comply with a number of water quality criteria.

26 — *Ibid.*

27 — *Ibid.*

28 — *Ibid.*

SARP's Evolution: From Water Evacuation to Water Treatment

Sewage worker, 1935
© La Pompe Cornouailles Association

In 1937, Charles Dubreuil created SARP: the Sanitation Company of the Paris Region. It was a vacuum truck company aggregated from smaller companies. Its goal was to benefit from the market share premium that existed in a sector that operated through word of mouth—the more clients there were, the more prescribers there were, and, in turn, the more clients there were—and to increase the quantities of excrement used as fertilizer for spreading. At that time, vacuum truck companies were created by farmers in search of fertilizer for their fields, such as CIG, which joined SARP in the 1980s: it was originally founded by a tulip farmer from Gonesse in the Val-d'Oise.

The success of SARP, which emerged in a fragmented sector of small players, symbolizes the change of an era, from a rudimentary approach to a more technical approach and from solely evacuating sludge to treating it. Trucks replaced men and horses; they were expensive and required funds. Treatment centers, especially, with an expanding range of treatment options, needed volumes to operate. SARP sensed the changing times, which placed increasing importance on science. In the 1960s, it changed the meaning of its acronym to become the Rational Sanitation and Pumping Company.

Driven by an entrepreneurial spirit, SARP then developed its activities by progressively penetrating a broad range of markets and by making itself a permanent field of innovation.

"Starting from individual septic tanks, we thought it would be beneficial to clean collective sanitation networks and offer solutions for emptying and cleaning industrial equipment," recounts Marc-Olivier Houel, who was the CEO of SARP from 2013 to 2023. "And since the waste resulting from pumping was sandy, greasy, oily, and hazardous, we quickly implemented appropriate solutions to protect the environment, support our clients, and enhance our professional skills."

On the vacuuming front, alongside the activity of cleaning individual septic tanks, which continued to thrive—France still has too low a population density to connect every household to the network, unlike many other Northern European countries, and still has at least four million septic tanks—the activity of cleaning city and industrial sanitation networks developed. In the 1980s, the first remote inspection techniques appeared, initially using VHS cameras "before resorting to drones today," says Yannick Ratte, CEO of SARP in 2023. Other innovations appeared, such as the Vertigo technology which, by projecting an epoxy film inside the pipes, enables their rehabilitation without having to destroy the columns, to the great satisfaction of landlords.

On the treatment front, techniques were borrowed from the centers for hazardous waste treatment. Such wastes accumulated with the development of industry: "Who else could Renault, foreseeing future environmental issues, turn to at the time to pump the residue from its painting tanks at its Boulogne-Billancourt factory? SARP," Marc-Olivier Houel recalls. This allowed the Compagnie Générale des Eaux, which integrated SARP in 1970, to have initial solutions in place when it was confronted a few years later with pollution at the drinking water plant in Méry-sur-Oise, allowing it to treat the problems at the source and quickly giving birth to SARP Industries, which has since become a reference point in the treatment of hazardous waste. At the same time, SARP launched the first treatment centers for dredging sludge, washing the sands and valorizing the greasy residues—a first in France. These developments and innovations position this Veolia entity at the crossroads of all its businesses today

Rainwater: From Evacuation to Recovery

During the initial period of sewer system construction, the decision was made to collect rainwater and wastewater together for rapid evacuation from cities, aiming to reduce both diseases and flooding. This original choice of evacuation still underlies the most common sanitation scheme today.

However, this approach was not without disadvantages. During the sanitation process, it has become apparent over time that rainwater, polluted by runoff that carries pollutants as it washes over soils and buildings, may not actually be polluted enough for the optimal operation of wastewater treatment plants. “The problem is that for a wastewater treatment plant to function properly, it needs pollution,” says Cyril Gachelin, a specialist in rainwater and responsible for training at OiEau. “With rainwater, the purifying bacteria are less effective in diluted environments, and the facilities are subjected to hydraulic overloads. We realized that rainwater caused certain dysfunctions in wastewater treatment plants.”

Since the 1990s, this approach has been refined: increasingly, rainwater and wastewater tend to be collected through separate networks. Rainwater is now considered “clear parasite water” for the sewer system. This means that rainwater poses risks of wear or overload to the pipes, excessive electricity consumption, and a decrease in the efficiency of wastewater treatment plants. This evolution entails significant operational consequences and its impact must be assessed in each locality; separation requires extensive work on the water network, which is why this choice is rarely adopted by authorities, and wastewater treatment plants can be adapted in its absence.

In order to combat flooding, the infiltration of water into the soil has emerged as an essential complement to simply evacuating rainwater. In mainland France and the overseas departments, between the 1980s and 2020s, “between 200 and 250 square kilometers [of land were] impermeabilized annually, which is equivalent to a French department every twenty-five to thirty years,” according to the Ministry of Ecological Transition. However, soil impermeability, coupled with the more frequent occurrence of heavy rainfall, contributes to dangerously worsening the risk of flooding. Therefore, promoting the infiltration of rainwater directly into the soil is necessary. Considering that 75 to 85 percent of the pollution in rainwater is due to runoff, this approach also helps limit pollution at the source and even harnesses the purifying power of the soil. “The current objective is to limit urban sprawl to reduce the phenomenon of impermeability. To achieve this, we need to make supermarket or cinema parking lots less impermeable. We need to restore infiltration capacity to rainwater, especially through vegetation,” explains Gachelin. In housing, the development of green roofs also increases retention areas where water can evaporate.

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Finally, the question of rainwater harvesting arises. Knowing that only one percent of the water available on the planet is usable for human consumption, the billions of cubic meters of rainwater that fall are a resource that must be taken into account (though without depriving the soil).

"In France, we have regulations for indoor use," Gachelin emphasizes. Rainwater can be collected within a dwelling, but it is not without constraints. It can be used to fill toilet cisterns, clean floors, and for laundry washing "provided that an appropriate water treatment system is used, a 'non-potable water' label is placed on the toilets, and it is reported to the local municipality, as some of this rainwater will eventually end up in wastewater." It is not permitted for human consumption. Even for the authorized uses, "to be self-sufficient in rainwater, a very large storage capacity is required. However, it doesn't rain every day, and the investments required for self-sufficiency are significant. Moreover, rainwater can be used for individual irrigation purposes outdoors."

For professionals, the use of rainwater is allowed if the applications do not require potable water. In the summer of 2022, in France, "car wash stations had to close due to water restrictions," Gachelin said. "For them, it can be beneficial to store large quantities of water or opt for closed-loop solutions to cope with these periods of drought."

Individual solutions should be complemented with collective solutions, tailored to the needs identified by the local area. For example, Veolia initiated the storage of 300,000 liters of rainwater as a massive "cushion" (pond) in Nantes in 2012, to supply eleven street sweepers responsible for cleaning the city streets ●

in the soil to grow plants. However, we realized that there was not enough land to discharge all the wastewater; it became saturated. That's when we started building the first wastewater treatment plants," adds Besnault.

A major innovation of the early twentieth century was the discovery in 1914 by two British researchers, Edward Ardern and William Lockett, of free cultures or activated sludge. The principle: use naturally occurring bacteria to purify wastewater. "In basins, we inject air to sustain the bacteria. As they thrive, the bacteria consume nutrients. Through sedimentation, we separate these bacteria from the water, transfer them to large basins, and let them settle at the bottom," explains Besnault. Even today, activated sludge, a natural solution, is the predominant process used for wastewater treatment in our country. "Half of the wastewater treatment plants in France operate with activated sludge. This is the case for all plants serving populations of more than ten thousand," Besnault adds.

The first French wastewater treatment plant was established in 1940 in Achères, Yvelines, after three years of construction. In its early stages, the sanitation service was entirely dependent on the state. As Séverine Dinghem points out, "The private sector, including the Compagnie Générale des Eaux, was only involved in the collection and treatment of wastewater at a later stage because this public service was directly funded by the public, not by the users," and the importance of the relationship with users in engaging private companies was recognized.

Only later, after World War II and especially after the French Water Law of 1964, the invoicing of sanitation services to users, the increasing complexity of industrial pollution, and the development of technologies motivated the launch of public-private partnerships and the establishment of wastewater treatment plants across the country.

Methods with similar foundations are used for the treatment of drinking water and wastewater: physico-chemical, biological, and chemical processes that rely on the oxidation of compounds. Since the early twentieth century, these methods have continuously progressed to consume less energy, occupy less space, treat larger quantities of water, and remove increasingly specific pollutants.

New Pollutions and Planetary Limits: Challenges for the Future

Today, water treatment strategies must confront multiple challenges. And, as has been the case for the past 170 years, health-related challenges persist. As pollution becomes increasingly complex, whether of agricultural, industrial, or even medical origin with the presence of pharmaceutical residues, the capability to detect particles is also improving. This opens up new possibilities for treatment.

Health: New Solutions in Detection and Prevention

Veolia actively participates in hazardous substance detection efforts. Since the adoption of a European directive in 2000, the search for hazardous substances in water discharges has been mandatory in wastewater treatment plants serving populations of more than ten thousand. To meet this requirement, the company, in partnership with Watchfrog, has developed a solution to detect potential toxicity related to the presence of endocrine disruptors or micropollutants in wastewater effluents.

"To treat these micropollutants, we mainly use water treatment technologies at the outlet of wastewater treatment plants," says engineer Sophie Besnault. "However,

The first French wastewater treatment plant was established in 1940 in Achères, Yvelines.

© Eberhard Grossgasteiger

the treatment of these micropollutants requires a significant amount of energy and resources." Since the 1990s, water treatment plants and certain wastewater treatment facilities have implemented membrane ultrafiltration, which has revolutionized the field and continues to improve. Veolia is currently working on two types of filters with exceptional potential: carbon nanotubes and membranes that imitate fish gills. The aim is to make these technologies more accessible and energy-efficient.

Overall, technological advancements now allow the filtration of pollutants that were undetectable just a few years ago. In Aarhus, Denmark, Veolia conducted an initial experiment in 2014 to treat pharmaceutical residues from a hospital and a municipal wastewater treatment plant. Using Moving Bed Biofilm Reactor (MBBR) technology, which utilizes microorganisms to degrade organic matter, 90 percent of the pharmaceutical residues were eliminated. The tests also demonstrated the need to prioritize the treatment of municipal wastewater, since people consume medications at home. But it is crucial to address these residues at the source: the best pollution is the one that is not produced. "Beyond the numerous technical solutions available to identify, measure, and eliminate micropollutants in water, we must also consider changing mindsets," explains Géraud Gamby, Water Market Director at Veolia. "By organizing awareness campaigns for citizens and economic actors and leveraging community networks, we need to focus on changing habits and practices."

Environment: Contributing to the Respect of Planetary Boundaries

Water treatment processes, like all human activities, must adapt to climate change, which poses significant challenges in terms of water quantity and quality. "During drought episodes, water quality deteriorates with algal growth and increased concentration of matter. This makes water more challenging to treat, requiring stronger treatment steps," says Hervé Paillard, Director of Process and Industrialization at Veolia. Additionally, these processes must contribute to collective efforts to respect planetary boundaries, whether related to climate change, the freshwater cycle, nitrogen and phosphorus cycles, or biodiversity.

Research efforts to make water treatment processes more energy-efficient, less water-intensive, and better equipped to address environmental pollution play a role in meeting these challenges. "The new generations of membranes are more

efficient," says Anne Le Guennec, CEO of Veolia Water Technologies. "Often developed to meet the demands of industries, which are highly demanding in terms of performance and reducing their impact on the environment, these technologies are also being deployed for municipal use."

However, it is not only a matter of technology; individuals must make the best use of available treatments by taking the objectives into account as well as local circumstances. This is particularly true for nitrogen treatment. "We are committed to fulfilling our mission," says Pierre Ribaute, CEO of Veolia's Water Business in France. "The reduction of nitrogen in water below regulatory thresholds is a priority for us to protect the environment. The available technologies allow us to achieve this. However, we must avoid excessive treatment that may lead to over-quality, because nitrogen treatment produces nitrous oxide, a greenhouse gas much more potent than CO_2. Lean management, which empowers field teams, should help us achieve a balance." This balance is crucial for ensuring human health and preserving the planet

Wastewater treatment plant in Rennes-Beaurade.

Facing COVID: Innovations for Detection and Prediction of the Epidemic

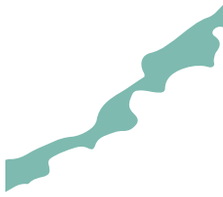
@ Girl with red hat

The global lockdown experienced in 2020 highlighted the crucial role played by Veolia's essential services. The true value of clean drinking water, sanitation in cities, and energy supply were recognized. Without the mobilization of Veolia's teams, both in the field and remotely, additional crises would have compounded the health crisis. Since then, Veolia's research teams have been devoted to developing analyses to detect and track the epidemic by analyzing wastewater. Their surveillance system, Vigie-Covid-19, has provided valuable insights and supported local decision-making by detecting the virus, monitoring its evolution, and serving as an early warning indicator for its probable circulation in the population.

This system places the analysis results in context by considering factors such as rainfall and population equivalents and comparing them with public epidemiological data. The temporal evolution of the results helps identify possible resurgences of the epidemic. Vigie-Covid-19, according to Philippe Sébérac, Director of Technological and Scientific Expertise at Veolia, has proven to be "an excellent complement to clinical trials in the fight against the spread of the epidemic, providing interpretable information and dynamics consistent with the incidence rates reported by health authorities in Europe."

Monitoring wastewater is a promising approach to anticipating viral-origin epidemics. As early as 2003, the World Health Organization recommended this method for polio prevention. The international scientific community now agrees that wastewater "partially reflects the population's health status."

CHILE



In Chile, the Risks of Water Pollution Are Acute

Mining activities, industrial waste disposal, and inadequate wastewater treatment have long polluted rivers and groundwater, making them unfit for human consumption and damaging fragile ecosystems. Agricultural practices such as the use of pesticides and fertilizers also contribute to water pollution, posing risks to human and wildlife health.

To address these challenges, Aguas Andinas, a subsidiary of Veolia in Chile, has embarked on the construction of a comprehensive water service, particularly in and around Santiago, ranging from drinking water supply to wastewater treatment, effectively putting an end to the waterborne disease outbreaks that were once frequent there.

Aguas Andinas has made significant contributions to the sanitation of the Mapocho River. Until 1999, only 3 percent of Santiago's wastewater was treated, with the rest being discharged

into the river, resulting in devastating consequences for both the ecosystem and public health. Thanks to initiatives such as the Mapocho Urbano Limpio project, which eliminated wastewater discharges into the region's main watercourses, the situation has radically changed in just over a decade.

The benefits are tangible, with a rapid decrease in epidemics being the most prominent. A study by the University of Chile revealed that mortality due to diarrheal diseases among preschool children dropped from 3.8 per 100,000 inhabitants in 1990 to 0.6 in 2003, demonstrating the positive impact of sanitation on public health.

Sanitation has also led to improvements in the river's condition and ecosystem. Moreover, the treated water can now be reused for agricultural irrigation, parks, sports facilities, and even for recharging aquifers, thereby enhancing the water resources available for the region. Consequently, Aguas Andinas has helped to end decades of water rationing.

This is a noteworthy benefit amid the new tests posed by climate change, which is reviving the old challenge of an uncertain water supply in the Chilean capital. Water shortages are a prominent issue throughout the country. The resource is particularly scarce in regions with arid and semi-arid climates. Precipitation is limited and irregular and, combined with its heavy use for economic activities, results in insufficient water resources. Santiago, with 70 percent of its water supply dependent on the Maipo River into which the Mapocho flows, is no exception. Aguas Andinas has invested in diversifying water sources, tapping into new wells and storing drinking water. As a result, neighborhoods dependent on the Maipo River have seen their autonomy increase from four hours in 2011 to twenty-four hours ten years later.

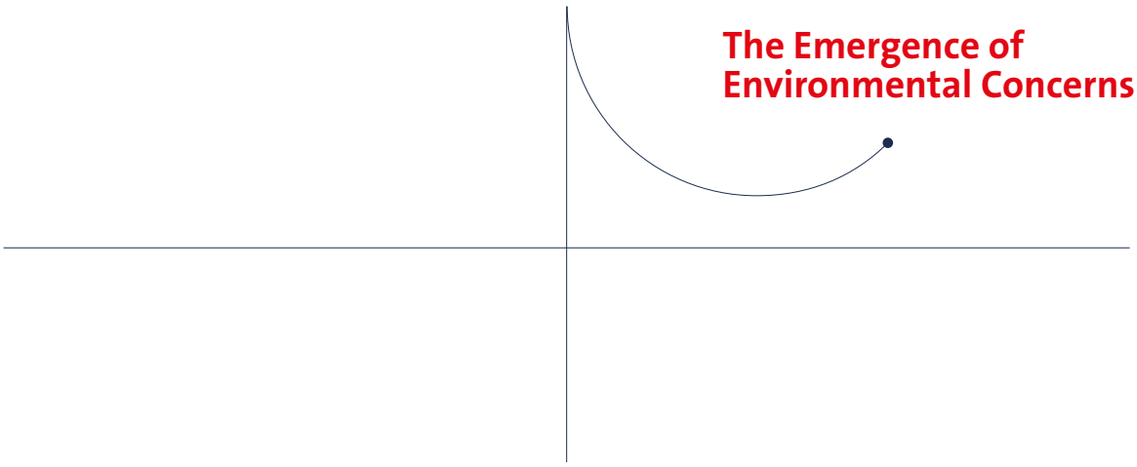
These advancements prevented water rationing in 2021, when exceptional heavy rains upstream of the Maipo River caused landslides that heavily contaminated the water, causing problems for its potabilization. Seven million people who escaped water scarcity then realized the impact of the group on their daily lives. The current objective is to achieve forty-eight hours of neighborhood autonomy and continue all the actions taken to reduce the vulnerability of Santiago.

To avoid a return to strict rationing after more than a decade of drought, Chilean authorities planned adaptation and water conservation measures in 2022, to which Aguas Andinas has contributed ●

Story
4

Protecting Natural Resources

The Emergence of Environmental Concerns



When running water was brought into cities in the mid-nineteenth century, few were concerned about the impact of what was discharged directly into bodies of water downstream. The need to carefully protect water resources arose from the explosion of pollution and the shift in pollution patterns, which changed it from being odorous and visible due to tanneries and slaughterhouses to being odorless and invisible due to the development of chemistry and industry.

In today's world, the ongoing environmental challenge lies in developing expertise that connects new water uses with their environmental impacts, considering both the immediate and long-term consequences. This involves prioritizing appropriate technical solutions to address these issues. Alongside scientific experts, lawyers, and administrators, many anonymous individuals also play a role in this process, using their empirical knowledge of the field to observe modifications even while they are still largely invisible. This history of mobilizations around water is gradually becoming known to the general public and shows no signs of stopping ●

GRÉGORY QUENET

"Water is part of the common heritage of the nation. Its protection, enhancement, and the development of usable resources while respecting natural balances are of general interest." This is what French law has stipulated since 1992, the result of decades of ecological struggle, scientific studies, and political choices. In the same year, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes was signed in Helsinki, aiming to "ensure rational and environmentally sound management of transboundary waters, make reasonable and equitable use of transboundary waters, and ensure the conservation or restoration of ecosystems." This is because rivers, streams, and lakes do not stop at borders; they continue their course wherever nature leads them. Therefore, the protection of major hydrographic basins requires both local management, which allows for practical control and knowledge of the resource, and global management, which can provide cross-border coherence to national legislation. As another action to contribute to the preservation of the aquatic ecosystem, certain countries have granted legal personhood to their rivers, as is the case in India for the Ganges. In 2017, New Zealand also granted "living entity" status to the Whanganui River. In India, citizens can take legal action on behalf of the sacred river, while in New Zealand, the river's interests will be defended in legal proceedings by a lawyer.

The ecological issues related to water are expanding in scope and involving issues never raised before: questions regarding biodiversity, landscapes, climate and the like. It is worth noting that climate change has firmly established itself in our minds and bodies following the exceptional drought across the Northern Hemisphere in 2022 and the devastating wildfires in North Africa, Australia, and Europe. According to the Elabe Veolia Barometer of Ecological Transformation, published in 2022, 71 percent of the world's population expresses a sense of ecological and climate vulnerability, and 74 percent feel exposed to the degradation of biodiversity and the ecosystem in their country. Environmental awareness now extends beyond regional or national boundaries, where it originally emerged, to become a global issue, and the protection of water resources aligns with concerns about the overall conservation of biodiversity.

This has not always been the case. At the end of the nineteenth century, when the focus was on urban sanitation, the primary concern was to discard waste far away using the kinetic energy of water. Even Louis Pasteur envisioned a system that would "directly lead waste to the sea."

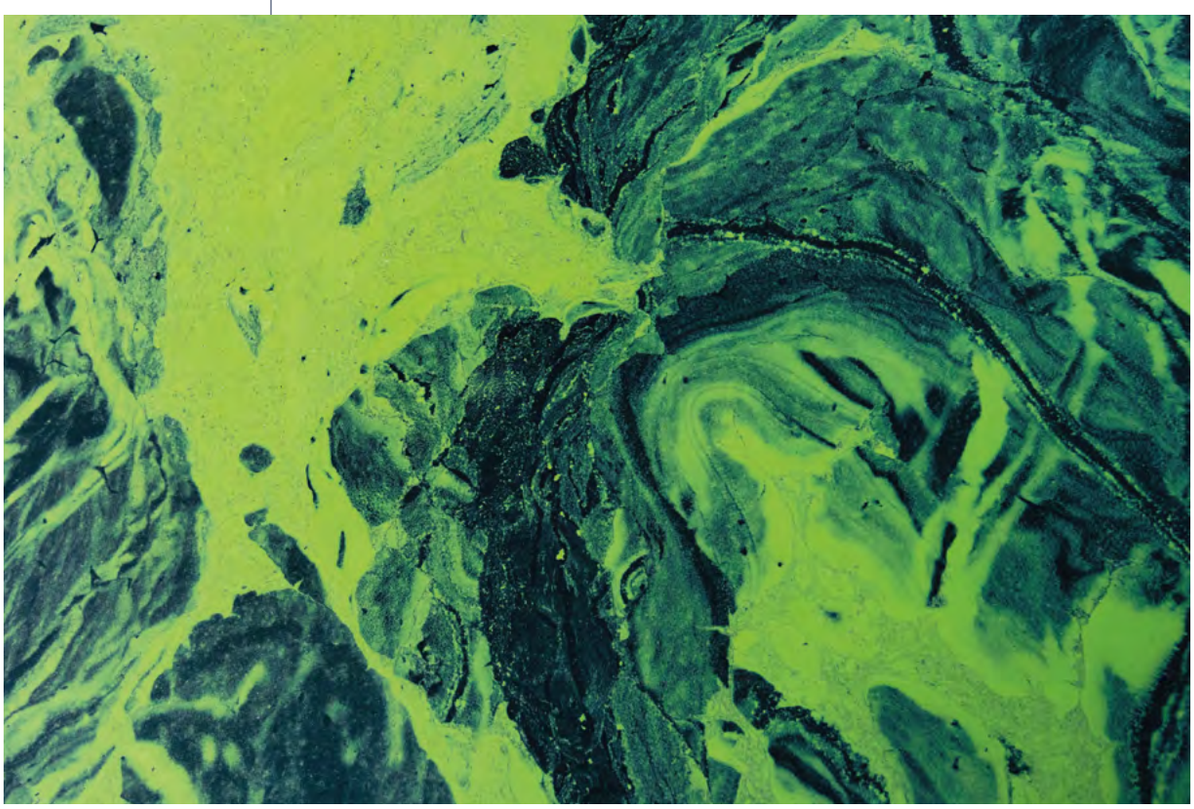
"Making waste invisible, odorless, and completely protecting the population from contact with it was the project—the utopia—that haunted the doctors" of that time, as Alain Corbin informs us in *Le Miasme et la Jonquille (The Foul and the Fragrant*.[29] This anthropocentric vision was driven by the belief in water as a purifying force, capable even of purifying itself. At the bottom of a river or far out at sea, waste is invisible, and its case seems resolved. For decades, tons of waste, sometimes highly dangerous waste, were dumped, forgetting that the circular contamination of water which once caused cholera epidemics can occur on larger cycles and in larger areas beyond urban territories.

Even today, many regions around the world produce waste that ends up directly in the sea, lakes, or rivers. According to the World Health Organization, 45 percent of domestic wastewater is still discharged without adequate treatment. Yet, the protection of the resource and of ecosystems, while not initially a priority, now has a long history behind it. Let's delve into this history, which began at the dawn of the twentieth century ●

29 — CORBIN, Alain. *The Foul and the Fragrant: Odor and the French Social Imagination*. Leamington Spa: Berg, 1986.

From the Fishing-Club in France to the Landmark Water Law of 1964

Awareness of the need to preserve water resources emerged slowly in France, even after the construction of the first water networks. Initially, the theories of miasmatism, which attributed epidemics to foul odors rather than the intrinsic quality of water, persisted. The discoveries made by John Snow in London only date back to 1854—one year after the establishment of the Compagnie Générale des Eaux—and were initially contested by many scientists. It was not until the German researcher Robert Koch identified the *Vibrio cholerae* bacteria as the cause of cholera in 1883 that Snow's findings were supported. Moreover, urban sanitation initially focused on water supply rather than treatment. Consequently, preserving water quality at its source in its natural environment was not identified as a priority. However, scientific discoveries multiplied, and it was during the Third Republic, under the government of Waldeck-Rousseau in 1902, that one of the first major laws against groundwater pollution was passed in France. This law, known as the Edouard-Alfred Martel Law, prohibited "the disposal of dead animals into natural limestone cavities." Martel, a pioneer of speleology, demonstrated through his research on spring hygiene that decomposing matter could cause severe epidemics. This legislation can be seen as one of the first movements for the protection of water resources in France,



Edouard-Alfred Martel

PIONEER IN THE FIGHT AGAINST WATER POLLUTION

The Martel Law was enacted on February 15, 1902. This law, which prohibited the dumping of animal carcasses and putrefying waste in caves, bears the name of Edouard-Alfred Martel, a pioneer in both speleology and the fight against water pollution.

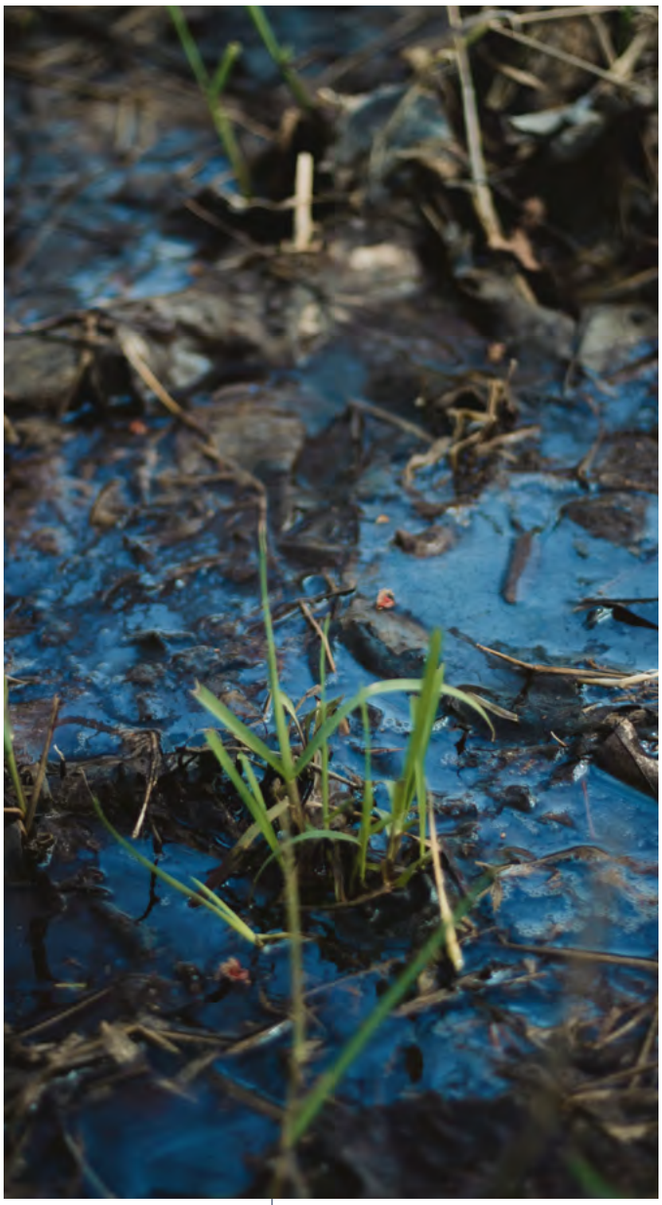
Born in 1859, Martel was expected to become a lawyer like other members of his family, but his life took a different turn. After discovering a cave at the age of seven, this future geographer, a fervent admirer of Jules Verne, developed a passion for the depths of the earth.

As a modern adventurer, Martel explored caves, underground spaces, and other cavities with unprecedented scientific rigor. He gained notoriety after discovering the underground river of the Padirac Abyss in Lot, France, in 1889. This abyss, with a depth of 103 meters, is home to a river that runs for over fifty-five kilometers. Martel's wife, Aline de Launay, described his underground adventures as follows: "I accompanied him and waited for him at the cave entrance, admiring the 'front' of the landscape while he discovered the 'back' in the bowels of the earth [...]. You should have seen the state he was in when he emerged! [...] A true sewer worker!"

Two years later, while exploring the Berrie Abyss in the Vert Valley, Martel spotted a decomposing calf carcass at the bottom of a well. After completing his exploration, the thirsty spelunker drank water from the spring and fell ill with typhoid fever, which lasted for two months. This event inspired him to conduct research on the hygiene of water sources. In 1894, he wrote, "What could be more dangerous and deceptive than these clear waters, seemingly filtered by rocks, but actually carrying an abundance of microbes germinated on carcasses at the bottoms of sinkholes? This is why public nutrition and hygiene are highly concerned by underground studies."

Edouard-Alfred Martel demonstrated that infiltration waters can carry serious epidemics such as typhoid fever. Hence, the father of modern speleology worked tirelessly to impose new hygiene rules. His work recommended that regions without filtering sandy soils pay extra attention to their water supplies and establish a "protection perimeter" against pollution. Thus, in 1902, the law enacted on February 15 established these protection perimeters and prohibited the dumping of dead animals and waste into natural cavities. Although he did not directly pursue a political career like the scientists of his time, such as Marcellin Berthelot, Paul Langevin, or Paul Painlevé, who were later honored in the Panthéon, Martel nonetheless gave his name to this law because of his active advocacy on its behalf.

With typhoid fever infections decreasing by three-quarters in France, it is no wonder that Martel was recognized as a "benefactor of humanity." His research and discoveries on water pollution are compiled in a work titled *Le nouveau traité des eaux souterraines*, published in 1922 ●



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even though its application was limited in scope to freshwater springs.

Gradually, the changes brought about by the development of water networks revealed the need to protect the resource. The increasing quantity of human waste from growing cities made it impossible to spread it in the surrounding fields, especially since the influx of water into cesspools rendered this matter, now liquid, less usable. At the same time, a coalition of whistleblowers emerged, from scientists demonstrating the role of microbes in water contamination to recreational fishermen observing the impact of urban discharges on fish in water bodies.

The creation of the Fishing-Club de France in 1908, composed of a diverse range of members from recreational fishing enthusiasts to high-ranking government officials (such as water and forest inspectors), marked the beginning of a series of successful mobilizations during the first half of the twentieth century. An early example cited in a report by the Fishing-Club de France was the conviction of a paper mill and two workers to two months in prison and four thousand francs in damages "following the intervention of a Society of fishermen, for discharging washing water from soda resin basins into the Meurthe River, causing considerable harm to fish." In Condom in the department of Gers, in 1929, a petition signed by thirty-five fishermen alerted the prefect to the discharge of waste from coal distillation by a gas plant into the Baïse River. The prefect, along with the administration of Bridges and Roads, urged the mayor to construct a sealed tank to collect the washing water. Solutions needed to be implemented, and these early dynamics foreshadowed the long-term cooperation that would be established between fishing associations and the Veolia Group. As an example, even today, the teams of Eaux de Marseille never empty the Saint-Christophe basin, which allows sedimentation of silt, without consulting local fishing associations.

As highlighted by Stéphanie Laronde, head of the Support-Institutional and Technical Cooperation Department at the International Water Office, conflicts of use related to resource pollution began to multiply in the 1960s. The quality of surface water, particularly rivers, deteriorated significantly due to industrial and agricultural activities, as well as the rapid urban expansion taking place after World War II. It was in this context that the Water Framework Law of December 16, 1964 was enacted. This law, which organized basin management, set quality objectives for each river in every French department and established the polluter-pays principle.

Water

THE ANTHROPOGENIC WATER CYCLE: EFFECTIVE MANAGEMENT FOR PRESERVING WATER RESOURCES AND AQUATIC ENVIRONMENTS

01 Groundwater pumping

a. Pump only what is necessary, without disrupting the natural replenishment balance of the groundwater table (monitoring tools for water table levels, proactive planning, and consideration of meteorological conditions).

b. Establish protection zones around priority groundwater sources.

02 Pumping from rivers and streams

Managing water withdrawals from rivers and streams while preserving the minimum flows necessary for the life of aquatic ecosystems.

02 Lake pumping

Monitor the water quality of lakes while preserving ecological balances and anticipating the risk of degradation in water quality.

03 Drinking water production

Adapt treatment processes according to the quality of the water source to ensure the potable water quality required by regulations while avoiding over-treatment.

04 Distribution

a. In water transportation: ensure and optimize the delivery of water in terms of quality and quantity, and detect leaks using advanced tools (dogs, sensors, electro-acoustic detectors).

b. Reduce network pressure to promote water efficiency while ensuring fire protection.

c. For end-users: encourage water conservation in drinking water usage by working on behavioral changes (Eco d'Eau initiative, initiated by Veolia).

05 Wastewater collection

a. Collect urban wastewater without discharge into the environment.

b. Manage stormwater to avoid disruptions in the wastewater system.

c. For specific industrial establishments: establish discharge agreements to control wastewater discharged into networks at the source.

06 Wastewater treatment

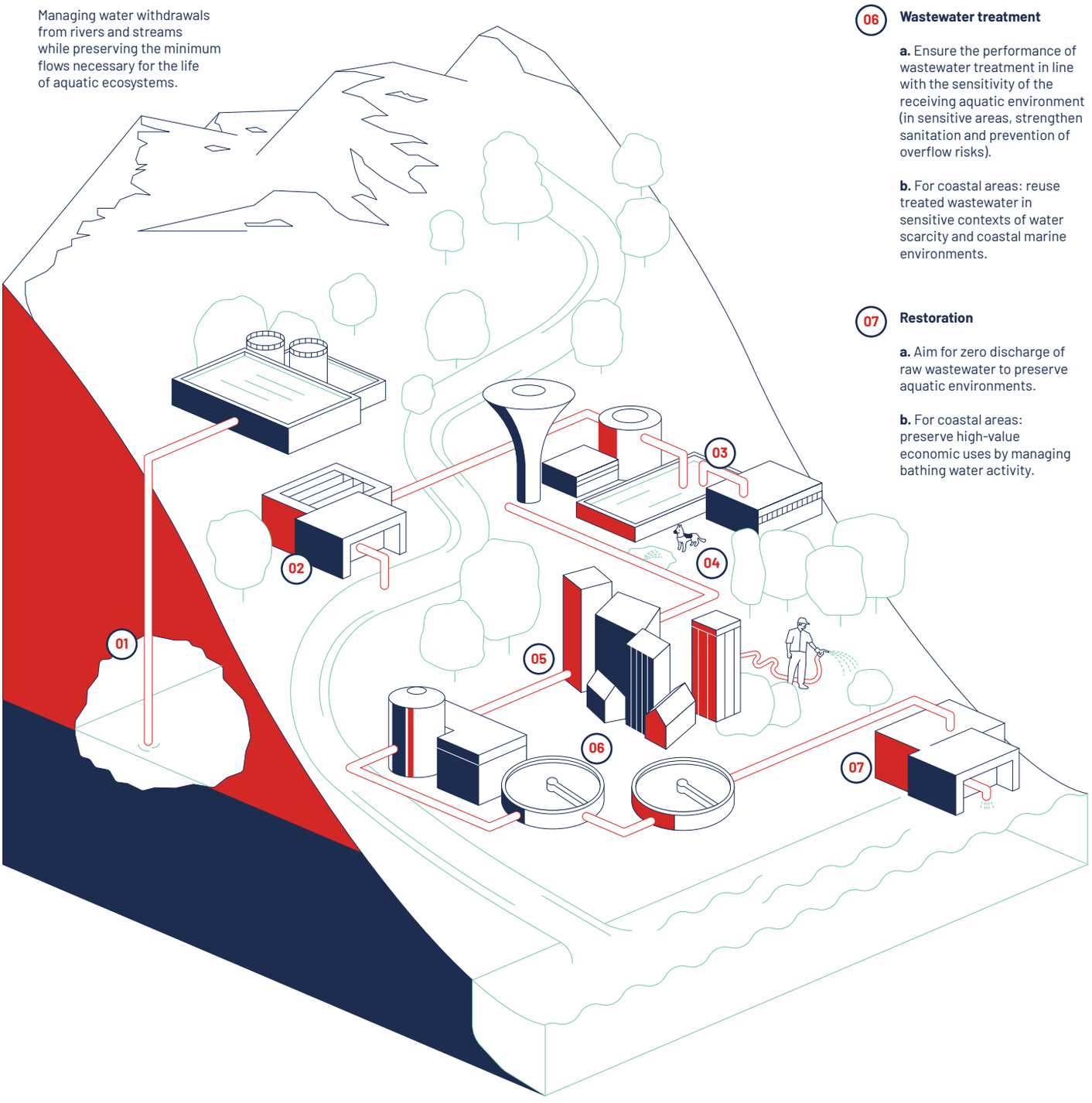
a. Ensure the performance of wastewater treatment in line with the sensitivity of the receiving aquatic environment (in sensitive areas, strengthen sanitation and prevention of overflow risks).

b. For coastal areas: reuse treated wastewater in sensitive contexts of water scarcity and coastal marine environments.

07 Restoration

a. Aim for zero discharge of raw wastewater to preserve aquatic environments.

b. For coastal areas: preserve high-value economic uses by managing bathing water activity.



The 1970s: A Turning Point in Environmental Activism; New Solutions to Meet Demands

While the Water Framework Law provides a regulatory framework and financing measures, the economic model for industrial effluent treatment only took shape a little later. In the early 1970s, initiatives in this field were often the work of isolated individuals, such as the director of the water treatment plant in Méry-sur-Oise, who realized that the water was occasionally too polluted to be drawn and treated properly. Jean-François Nogrette, head of the France and Special Waste Europe division at Veolia, recounts this story: "At the time, the Oise River was like a sewer! Along its course, there was a highly developed steel industry that discharged heavy metals and cyanide. The river was on the verge of severe contamination and a water shutdown." To prevent such a situation, Bertrand Gontard, who was the director of the water treatment plant at the time, proposed that industrial companies treat toxic waste upstream. This activity did not yet exist in France but was made possible by the 1975 law on waste producer responsibility, as well as the contribution of basin agencies, established in 1964, which used the polluter-pays fee to finance treatment plants. As Jean-François Nogrette recalls, "The water agencies understood that to protect the water resource, it was necessary to dispose of this toxic waste, now called 'hazardous industrial waste,' upstream, without passing it through any bodies of water." It is in the context of protecting water as a resource that SARP Industries was founded in 1975, specializing in hazardous waste and related to SARP (Rational Sanitation and Pumping Company).

The 1970s marked a collective awakening around environmental issues.

The 1970s marked a collective awakening around environmental issues. The United Nations Conference on the Human Environment, held in Stockholm in 1972, made the environment a major concern for the first time. Principle 2 of the Stockholm Declaration on the Human Environment states, "The natural resources of the earth, including the air, water, land, flora, and fauna, must be safeguarded in the interests of present and future generations through careful planning or management as appropriate." In the same year, the Clean Water Act was passed in the United States. The law aimed to reduce pollution in bodies of water, including the Great Lakes, which had become a major health threat. It brought about a radical paradigm shift: moving from a system based on water quality standards to one based on effluent discharge standards, providing a framework to reduce industrial and municipal discharge into water resources. It also initiated a federal program to fund wastewater treatment plants. With this law, the legislature aimed to eliminate "the discharge of pollutants into navigable waters by 1985" and "make waters fishable and swimmable by 1983." Although these goals were not entirely achieved, due to a lack of coercive measures, water quality in the Great Lakes significantly improved during the following decade, with pollutant levels dropping.

The 1970s was also a period of increased associationism,[30] as described by historian Pierre Rosanvallon in his book *Le Modèle politique français* (*The French Political Model*). During this time, "new types of nature and environmental protection associations emerged in France and around the world, from the French Federation of Nature Protection Societies (FFSPN, 1968) to Greenpeace (1971) and Friends of the Earth (1969)," as noted by Alexis Vrignon in the journal *Vingtième Siècle*.[31] The last association on the list was established in France under the name "Les Amis de la Terre," with members including Brice Lalonde and Yves Cochet. It was also a time for the first political ecology magazines, such as *La Gueule ouverte*, launched by journalist Pierre Fournier in 1972, and *Le Sauvage*, founded in 1973 by Alain Hervé of Friends of the Earth. Many of these activists and journalists supported the first environmentalist to run for president in the election of 1974, René Dumont.

30 — ROSANVALLON, Pierre. *The demands of liberty: civil society in France since the Revolution*. Cambridge, MA: Harvard University Press, 2007.

31 — VRIGNON, Alexis. "Écologie et politique dans les années 1970". *Vingtième Siècle Revue d'Histoire*, no. 113 (January-March 2012).

Water

A renowned agronomist and author of influential works like *L'Utopie ou la mort!* (*Utopia or Death!*, 1973), Dumont chose to symbolically drink a glass of water during his iconic, televised appearance. "I am drinking this precious glass of water before you because before the end of the century, if we continue with such excess, it will be scarce," he explained to astonished French citizens, who found his words exaggerated, if not downright ludicrous. As the first politician to emphasize not only water quality but also water quantity, René Dumont now appears ahead of his time in trying to convince a population mainly concerned with inflation due to the first oil crisis to pay more attention to ecological issues.

In those years, ecology emerged sporadically, primarily through local controversies whose aim was to preserve an environment in the form of a landscape or population that was threatened by an easily identifiable danger. Some of the most famous battles for the preservation of water and ecosystems took place in Brittany, starting with those related to oil spills. In March 1967, the tanker Torrey Canyon ran aground off the British coast, releasing 120,000 tons of crude oil. Despite their efforts, the English failed to contain the water pollution and, three weeks later, the oil reached northern Brittany. In order for the tourist season to take place, volunteers and the French Army worked tirelessly to clean the beaches using whatever means available—sometimes even with their bare hands—before burying the oil waste in trenches dug on a nearby island. While this first oil spill left a lasting impression—Serge Gainsbourg even dedicated a song to it on the album *Initials B.B.* (1968)—other similar disasters occurred in the succeeding decades, including the Amoco Cadiz in 1978, the Tanio in 1980, and the Erika in 1999. Veolia, through its subsidiary SARP Industries, supported coastal cleaning operations. Jean-François Nogrette testifies: "Every time there is an industrial accident somewhere, our teams are urgently called upon, with both technical and security stakes. So, a large part of the most prevalent pollution has been treated by SARP Industries units during oil spills since the Erika."

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At the same time, Brittany was beginning its fight against green algae. The proliferation of these plants has been polluting the Breton beaches every summer for fifty years, making the region the third largest "green tide" site in the world, behind the Venetian lagoon and the coastline of Qingdao in China. This phenomenon, first observed in 1971 in the Bay of Lannion in the Côtes d'Armor, is caused by pig farming and agricultural fertilizers. The nitrate runoff from these activities into the soil and waterways leads to the proliferation of green algae, which suffocate aquatic fauna and flora. Depending on the year, between 75 and 115 sites are affected, and forty to fifty municipalities collect between twenty thousand and forty thousand tons of stranded algae to prevent tourists from

An entire approach to water quality has become popular, prioritizing pollution prevention over treatment.

going to other seaside resorts. In addition to the nitrate runoff into the soil and groundwater, even drinking water has occasionally been threatened in Brittany. This situation is taken seriously by operators like Veolia, who, among other things, developed the Aquisafe project with the SMEGA in response to the closure, in 2009, of the Ic drinking water plant due to high nitrate levels. Aquisafe is a research project on buffer zones in rural areas. These zones are landscape elements intended to limit the transfer of contaminants to receiving aquatic environments such as embankments, ditches, and wetlands. The tests carried out with the implementation of these buffer zones at pollution points in the watershed have demonstrated that these zones result in a significant reduction in pollutants present, particularly nitrates. These actions have been coupled with rising awareness among local farmers of the problems caused by pesticides, resulting in a reduction in their use and an improvement in water quality. More broadly, an entire approach to water quality has become popular, prioritizing pollution prevention over treatment and mobilizing treatment only when necessary.

From Water Preservation to Habitat Preservation: Highly Ambitious Goals

The way to characterize water quality itself has become more precise over time. "The construction of water quality has evolved, especially thanks to the exponential development of quality descriptors from 1850 to today," taking into account criteria that are primarily important for habitats, emphasizes Marie-Christine Huau, the Water and Climate Director at Veolia. Several ages or periods can be distinguished in this history. The first phase is that of pharmacists, who undertook an inventory of hydrothermal sources based on physical variables: the values of mineral ions, temperature, pH, TSS (total suspended solids), and hardness (like the information found on a mineral water bottle). Then, still in the nineteenth century, came the era of analytical chemistry: oxygen, nitrogen, nitrates, and major ions were measured. This period was quickly followed by the time

Wastewater treatment plant Amphitria at Cap-Sicié

of civil engineers and river chemistry, with the measurement of degradable organic carbon and biological oxygen demand. The focus was mainly on protecting populations against waterborne diseases and problems related to bacteria that could be found in drinking water.

The qualification evolved between the 1950s and 1960s. As water became a resource for aquaculture, industry, and agriculture, biologic variables based on the fauna in the water attracted the attention of geochemists. This was a time of sanitary risk, when people began to ensure that bathing waters did not contain bacteria or pesticides. “We start[ed] to observe aquatic ecosystems from the perspective of their uses,” says Marie-Christine Huau. “From the 1980s, academic research focused on understanding the functioning of the aquatic system” before entering the era of ecological quality of the natural environment in the early 2000s. “We look at how this ecosystem works: Is there good oxygen circulation? Do we live well in it? Scientists shift to a hydrobiological approach using biotic indicators on different species of biodiversity. The goal is the preservation of aquatic habitats,” highlights the agronomy engineer. This is particularly important, as ecosystems, sometimes resources and sometimes receiving environments, are essential elements for biodiversity and for the common interest.

The broadening of approaches to water quality, taking into account its effects on humans as well as on the environment, has been accompanied by an increased focus on ecosystems, leading Veolia to invest not only in the sanitary quality of water but also in its environmental quality. The restoration of the underwater ecosystem of Cap-Sicié, near Toulon, is symbolic of this. For decades, sewage was directly discharged into the sea, causing severe degradation of the environment. In the late 1990s, to address the situation and respond to the first alert raised by a diver in 1980, a wastewater treatment plant was built by Veolia, under the impetus of the authorities. As expected, it quickly restored water quality, but contrary to expectations, it did not lead to the return of life to the environment. To make this possible, the Remora project was initiated in 2011 by the Veolia Foundation, the Rhône-Mediterranean-Corsica Water Agency, and the Paul Ricard Oceanographic Institute. It created artificial reefs composed of lightweight structures made of fiberglass and epoxy resin, capable of adapting to the waves, reefs designed to serve as habitats and protection for microfauna and microflora. The return of life was finally confirmed: in 2016, field research revealed the presence of squid, cuttlefish, and wrasse spawns, as well as juvenile crustaceans, octopuses, and fish.

Today, it is finally possible to solve problems of industrial discharges that have long impacted the environment. This is the case with the pollution affecting the coves

© Markus Spiske

of Marseille, downstream of the alumina production by the Gardanne plant, operated by Alteo. Ordered to bring its plant into compliance as quickly as possible, the company had to find a solution in order to maintain its historical activity in the region. This is a strategic issue for the area, considering the jobs at stake and the French sovereignty represented by aluminium production, an essential component for the manufacturing of smartphone screens, electric vehicle batteries, and tiles. Veolia enabled Alteo to treat its effluents after two years of experimentation and the creation of a biological treatment unit using bacteria to degrade suspended organic matter. “The treatment plant we created uses biomass: it replicates what happens in nature using bacteria that eat pollution,” says Anne-Laure Galmel, project manager for the Mediterranean region at Veolia Water France. The result is the highest quality of residual water in the aluminium sector worldwide and satisfaction expressed by environmental advocates, such as Didier Réault, director of the Calanques National Park: “Alteo has succeeded in managing its discharge in compliance with European standards. It’s a real success. We have succeeded in reconciling both ecology and the economy.”

Today, it is finally possible to solve problems of industrial discharges that have long impacted the environment.

However, the protection of the environment remains a vast challenge, first because wastewater treatment and pollution prevention in general are still not implemented everywhere, but also because climate change is reshaping the ways in which environmental protection is approached. It disrupts the water cycle, reducing river flows and concentrating pollution and salinity, all of which pose threats to species. The struggles and solutions must continue ●

UNITED STATES

In New Orleans: Resilience between Infrastructure and Ecosystem Protection

For over thirty years, the Sewerage & Water Board of New Orleans (SWBNO) has partnered with Veolia to manage water sanitation, creating one of the largest public-private partnership agreements for wastewater treatment in the United States. This partnership now goes beyond that, ensuring climate resilience for a city, New Orleans, which came to symbolize the risks of climate change after the devastating Hurricane Katrina in 2005.

Over the years, this partnership has led to improvements in the performance of both wastewater treatment plants, which in turn has strengthened the ecosystem of the Mississippi River and achieved environmental compliance for New Orleans. This provides a sense of security for a city located below sea level and near multiple bodies of water, making it highly vulnerable to natural disasters.

Hurricane Katrina itself served as an opportunity to enhance the resilience of the facilities. When it struck New Orleans in 2005, the East Bank plant was flooded under five meters of water. The staff was evacuated by helicopter. Once the waters receded, Veolia called in additional teams to work around the clock. Their dedication, along with the mobilization of resources from the group on an international scale, allowed the plant to be drained in thirty days and full treatment to resume within three months. Veolia invested thirty million dollars to immediately restore the plant, without waiting for the insurance reimbursement. To prevent the recurrence of such disasters, Veolia now incorporates climate protection and resilience measures into every investment project.

Today, Veolia's partnership with New Orleans goes beyond wastewater treatment infrastructure. The company supports a wetlands restoration project near the East Bank plant in the Lower Ninth Ward, contributes to neighborhood associations, and has donated over one million dollars to aid hurricane victims. Veolia also supports local universities by recruiting students interested in STEM (science, technology, engineering, and mathematics) careers and has directed over 30 percent of its local expenditures to disadvantaged businesses in New Orleans ●

CZECH REPUBLIC

The Return of Trout to the Rivers of the Czech Republic

Over the past twenty years, the water quality of all Czech rivers has significantly improved. According to the Czech Environmental Agency (CENIA), this progress is primarily due to the development of wastewater treatment. Veolia, a prominent player in the country, actively contributes to the enhancement of its water quality. This long-term effort has paid off: several locally endangered species have made a comeback in the country's waterways.

To facilitate the reintroduction of trout, the "Trout Way" project was launched in 2011. Veolia initiated this project in collaboration with the Freshwater Giants association, founded by television presenter and extreme angler specializing in travel and natural history Jakub Vágner. The project's objective is to support the return of salmonids to Czech rivers over a five-year period. The initial results have been quite encouraging: over 60 percent[1] of the three tons of reintroduced trout in the Střela River, located in western Bohemia, have survived. In total, nine tons of trout have been released into Czech rivers with a survival rate of 70 percent.[2]

The program has been praised by the country's government and media. By contributing to the improvement of the ecological state of rivers and by benefiting local communities,[3] this project has inspired the reintroduction of sturgeon to the Danube River in Romania, as well as other, similar initiatives in Hungary and Slovakia ●

1 — Veolia (2015). *CSR Performance Digest Czech Republic.*

2 — *Ibid.*

3 — Veolia (2013). *CSR Performance Digest*

FRANCE

Mont-Saint-Michel: A Dam to Save the Monument from Sand

In the early 2000s, one of France's most iconic monuments was at risk of being completely buried in sand. After dominating the bay that now bears its name for a millennium, Mont-Saint-Michel, admired over the centuries, was threatened: the accumulation of thousands of cubic meters of sediments carried by the tides was gradually connecting it to the mainland, causing it to lose its status as an island.

A major challenge had to be overcome to save the natural setting in which the monument stands, to which Victor Hugo paid homage in 1881 with his lyrical words: "Saint-Michel rose alone on the bitter waves, Chéops of the West, Pyramid of the Seas."[1] After studies were conducted by the mixed syndicate formed by the relevant local authorities, created by the state in 1997, the dam was built between 2006 and 2008 and officially inaugurated in 2015. Veolia's teams were entrusted with its operation, tasked with harnessing the power of the Couesnon, the river that flows into the bay, to flush out the accumulating sediments when the sea allows.

Claude Laruelle, former regional director for Normandy and deputy CEO in charge of finance, digital, and procurement for the group, recalls: "It all started, as often is the

case, with a call for tenders. This one was a bit special, as it involved being the operator of the dam that would protect the mount."

To secure the operation of this engineering structure, Veolia relied on its ability to build trusting relationships with stakeholders in the field. "There was an immediate understanding with the director of the mixed syndicate," says the deputy CEO. "He needed someone reliable, capable of putting themselves in his shoes and engaging in quality dialogue to establish balanced contractual clauses." Veolia's expertise in operating a service, with all its implications—"establishing standby services, ensuring night shifts and staggered work hours, and ensuring information flow"—played a crucial role in obtaining the contract.

However, there is still a significant challenge. While the operating principle is simple—"the water is stored at high tide. It comes in, we close it off, and when the tide goes down, we lift the immense gates, which act as a sort of flush that pushes back the sand," explains Laruelle—Veolia has never been involved with dams before. Relying on the fundamentals, the teams are developing high-pressure hydraulic expertise to complete the project.

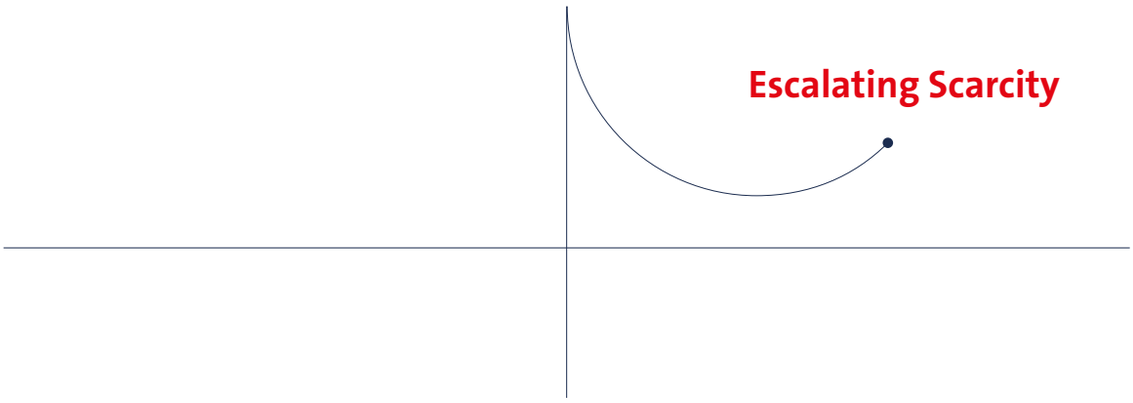
"This project truly symbolizes what the company can do," continues Laruelle. "We rely on our intimate understanding of the territory, develop new skills, and organize ourselves to manage both the long-term and the very short-term challenges." Managed closely and locally by the Avranches agency, the contract has contributed to Veolia's lasting presence "in the local landscape of La Manche."

"Here, the possibility of an island has been restored," declared French President Emmanuel Macron on June 5, 2023, during the celebration of the abbey's millennium. "In just a few years, the silting has been interrupted" thanks to this significant project that has been added "to the chain of times, from the first monks' construction on a mountain ravaged by storms a thousand years ago, to the triumph of human ingenuity over slope, gravity, and weight, through all the destructions and reconstructions." According to the president, it is a testimony that we need to remain "confident in our strength and humble in the face of the elements." ●

1 — HUGO, Victor. "Près d'Avranches", *Les Quatre Vents de l'esprit* (1881).

Story
5

Consuming the Resource



At a time when unlimited water consumption is being called into question, both for countries that currently benefit from it and those who aspire to it, it is important to understand how this ideal came about, considering that for centuries water consumption was always a trade-off between different uses. In fact, the needs of individuals have always come after those of navigation, energy production, industry, and the ostentation of the monarchy, while irrigation of crops was kept to a minimum and collectively regulated through common rights. Water supply varied depending on the seasons, with rivers and groundwater drying up in the summer and supply being disrupted by freezing temperatures in winter. Technological limitations restricted the use of water for the majority, as the art of water supply engineering made little progress from the Middle Ages to the Age of Enlightenment. The desire to consume water for personal use did not exist prior to a new understanding of hygiene, privacy, and the private sphere. Modern aquavore societies have broken free from this triple dependence on nature, technology, and a model of civilization. The challenge now is to rethink these connections: we are rediscovering our dependence on the seasons, which has never ceased in much of the world, while technology based on fossil fuels allows for increased pumping and desalination without considering ecosystems, thereby hindering the necessary shift toward a happy sobriety centered on reconnecting with the land on which we live and preserving its resources •

GRÉGORY QUENET

The modern conquest of water has led to profound changes in our way of life. Associated with sacred ritual for many centuries in Europe, from baptism to passage into the afterlife, water was gradually domesticated through science and technology. In the twentieth century, water became a prerequisite for modern comfort at home. The famous sign "Water and gas on every floor" proclaimed the availability of these utilities in upscale buildings, symbolizing a certain level of affluence in the early days when the Compagnie Générale des Eaux equipped major cities with their networks, before abundance became widespread. This was a time when modernity was mobilized for the water supply. Water brought the benefits of hygiene (washing, drinking, laundering, and dishwashing) and leisure at home (gardening and even swimming in one's pool). Then, quickly, came a period of forgetfulness. This comfort was achieved by freeing women and men from the burden of water: by burying networks, protecting water sources from human contact, and hiding wastewater treatment plants. Water thus became invisible, and our sensitive relationship with it was anesthetized. Historian Jean-Pierre Goubert even speaks of "amnesia,"[32] noting how our societies have forgotten "the hyphen between the body and nature that water represents." But what is repressed often returns, and the need to reconnect with water is stronger than ever, leading to urban renaturation, pedestrian and cycling developments along watercourses, and the opening of the Seine for swimming in 2025. Today, the scarcity of freshwater resources worldwide, even in historically temperate countries, has led to a global ecological awareness. The general public is discovering concepts such as water stress and the reuse of wastewater, which renew our relationship with water. Some want to monitor their consumption in real time to save money, while others want to collect rainwater to become more self-sufficient, but everyone fears the absence of this vital resource. It follows that the history of water and its consumption has been characterized by flows (the generalization of access to water) and ebbs (its invisibility). But it has also been written through the sedimentation of successive layers. Thus, the early stages of water domestication gave birth to water meters, which are now valuable allies in measuring and ecologically preserving the resource ●

Water Domesticated: Measuring the Resource to Better Control It

The saga of water in France started later than in England. Paradoxically, this allowed for the deployment of a crucial innovation: the water meter. In addition to resolving equity issues posed by other types of subscriptions, the water meter enabled control over consumption, which was skyrocketing at a time when the network was still too small, especially during periods of drought. Although poorly documented except in a few cities, the history of water service subscriptions has been well studied by researchers such as Konstantinos Chatzis, Bernard Barraque, and Frédéric Graber, who trace the various issues surrounding subscriptions based on gauges, free taps, and water meters. Originally, the gauge allowed heavy consumers to have a constant but low flow of water (hence the term "running water") according to a predetermined volume, while the free tap corresponded to the usage of small

32 — GOUBERT Jean-Pierre, LE ROY LADURIE Emmanuel. *La Conquête de Water. L'avènement de la santé à l'âge industriel.* Paris : Hachette, 1986.

consumers. The price of the subscription to the free tap was evaluated based on the most accurate estimate of daily consumption by individuals, regardless of actual consumption. In Angers in 1855, for example, it was estimated that each person in a household would use 20 liters of water, while 75 liters were allocated per horse, 50 liters per car, and 1.5 liters per square meter of irrigable garden. This gives an idea of the urban uses of that time, which were more focused on outdoor spaces (stables, courtyards, gardens, and streets) rather than domestic use. Jules Dupuit, an engineer from the Ponts et Chaussées, advocated for the "free tap," which he considered to be the payment solution closest to users' needs. His Treatise on Water Distribution, published in 1854, prompted many cities, including Paris, to adopt this subscription method in numerous households. However, criticisms quickly arose against this system, with detractors fearing abuses, as the "free tap" sometimes led to donations or resale between neighbors, which was prohibited. In reality, abuses related to this subscription were quite rare, especially since safeguards were put in place in certain municipalities, such as limiting the number of taps, push-button taps (similar to those still found in some public places, now replaced by motion detectors), tap restrictions, absence of sinks (to prevent users from leaving taps open for too long), overestimation of needs in subscriptions, etc.

Old photo of a well, Old Lyon neighborhood.

Water meters had existed for a long time when the Compagnie Générale des Eaux, the predecessor of Veolia, decided to install them for the first time in Paris and its suburbs starting in 1876, a time when it managed water distribution for the capital. As early as 1815, a meter was invented by the Siemens brothers and experimented with in England and Germany. However, it was the Kennedy meter from the Kilmarnock company in Scotland, improved by engineer Samain in the 1880s, that would be widely used in France.

The early meters were unreliable and did not immediately gain unanimous acceptance. They had to be tested and experimented with in a laboratory created for this purpose by the city of Paris in 1883—a predecessor to the Laboratory of Water Meter Testing (LECE), established by the Compagnie Générale des Eaux in Vanœuvre-lès-Nancy in 1976. Today, Veolia tests approximately five thousand meters per year, both new and used, as well as remote reading equipment and leak detectors since 2010.

As is often the case, it was an exceptional event that crystallized the debates around the use, or non-use, of the meter and the need to quantify consumption. In July 1881, a severe heatwave led Parisians to leave their taps running almost continuously, causing a water shortage in the city. In this context, the gradual implementation of meters became the most relevant solution

to prevent abuses and to equalize users faced with perceived unfair differences in subscription fees. This was particularly evident in the case of Cointreau, a liquor manufacturer in Angers, which was required to have a meter but complained to the mayor that not everyone was subject to the same requirement.

While the meter soon had the virtue of making French citizens more equal in terms of their water bills, subscribers to the meter paid a fixed portion, regardless of their consumption, as well as a variable portion when they exceeded the volume for which they had subscribed. Out of fear of exceeding this volume and in order to offset the high cost of the equipment, which ranged from one hundred to three hundred francs depending on the meter model, subscribers initially reduced their water consumption. This ambivalence toward the meter, which became widespread in France at the same time as the creation of the water distribution network, occurred in a situation where access to the resource remained a significant challenge requiring massive infrastructure that sometimes involved difficult expropriations. It was therefore advantageous for all stakeholders to measure the quantity consumed and to initially moderate its use.

The construction of numerous collection points and efficient infrastructure freed consumers and finally met the sanitary requirements of hygienists. In contrast, in England, the early creation of the network delayed the arrival of the meter: in a context of abundant water, authorities deemed it more useful to include the water bill in taxes rather than charging by the volume consumed. Even today, some households in Anglo-Saxon countries pay for drinking water through their taxes, at a rate linked to the rental value of their homes.

Becoming mandatory in 1934 by prefectural decree, metered subscriptions have had a lasting impact on water consumption habits in France. Long before ecological concerns emerged, they encouraged subscribers to ration their water consumption early on and prompted distributors to crack down on waste by identifying and repairing leaks. In urban areas, in particular, collective meters foster a necessary trust among the residents of a building, property owners, and the operator who calculates the billed water volumes—all partners in the hunt for leaks. This collective or "approximately accurate" metering promotes a form of solidarity that encourages virtuous behavior when it is accepted by all. However, ecological demands and increasing attention to water conservation are now challenging this solidarity: should meters become increasingly individualized, and should the benefits of water savings be more directly attributed to encourage everyone to contribute to the collective challenge?

The meter had the virtue of making French citizens more equal in terms of their water bills.

Abundant Water: Modern Comfort Accessible to All

By 1975, 97 percent of households had running water: the conquest of water was complete, and it brought about a transformation in our way of life. Published within a year of each other, Georges Vigarello's book *Le Propre et le sale: L'hygiène du corps depuis le Moyen Age* (*The Dirty and the Clean: Bodily Hygiene since the Middles Ages*, 1985) and Jean-Pierre Goubert's book *La Conquête de Water*: *L'avènement de la santé à l'âge industriel* (*The Conquest of Water: The Advent of Health in the Industrial Age*, 1986) illustrate how running water has revolutionized our hygiene habits in only a century. Behind the issue of hygiene, it is, in reality, a bourgeois vision of society that has prevailed over the declining aristocratic elite. The hygienist bourgeoisie opposed the frivolous beautifying practices of the aristocracy with the rigor of nature; they preferred the chaste and pure nudity of

the body over cosmetics that enhanced only visible parts of the skin. Previously, it was believed that changing clothes was sufficient for cleanliness, but now doctors recommended washing hands, face, and body with water. However, it took time for bourgeois morality, influenced by Catholicism, to no longer associate intimate hygiene with a form of self-gratification and, instead, conceive personal cleanliness as an unprecedented moral value. In the twentieth century, dirt became the shameful mark of the working classes, who needed to be taught a new physics of the body: fresh air, physical exercise, personal hygiene, as well as the fight against moral and health deviances such as alcoholism. This marked a complete reversal of mentality, a true revolution in which the Compagnie Générale des Eaux played a role. As researcher Dominique Lorrain explains, "In the mid-nineteenth century, water at home did not exist, neither technically nor in people's minds." Initially, both affluent and modest populations saw no need to change their habits, which were based on modest needs. It was only under the influence of hygiene and the Anglo-Saxon elites that behaviors began to change. In the mid-nineteenth century, the average French person consumed an average of twenty liters of water per day and relied on public fountains or water carriers for their supply.

In Paris, the commercialization of subscriptions was one of the main reasons why Prefect Haussmann turned to interested management: the teams of the company agreed to convince household staff to connect the homes they were responsible for to the water network and to overcome the resistant competition from water carriers. The pace of change accelerated when French elites compared themselves to their Anglo-Saxon counterparts vacationing on the French coast, for whom access to running water was synonymous with modern comfort.

The arrival of water at home was not enough, and hygiene in the household remained a luxury for a long time, as it required purchasing expensive equipment. Moreover, it required having enough space to dedicate an entire room to personal hygiene. For a large part of the nineteenth century, hygienic practices continued to take place outside the home: laundry was washed in public washhouses, bathing occurred in rivers or public baths, and drinking water was obtained from public fountains.

During this time, the bathtub made its appearance, but it was not fixed in place. Built on legs and not connected to plumbing, it had to be placed in a location convenient for heating water. For those who could not afford a bathtub, the English tub was imported—a sort of basin that could be moved around the dwelling and allowed for standing washing with minimal water usage, embracing the concept of frugality. Bathing scenes were immortalized by Degas in several nude pastel drawings during the 1880s. Other artists, such as painter Pierre Bonnard, made it a subject


DUPONT & Cie
LE CATEAU
(Nord)

Baignoires en fonte. Émail blanc à l'intérieur

Nos 7. BAIGNOIRES ANGLAISES A BORDS PLATS

Fig. 40

A système siphoïde de vidage et trop plein combinés . . . . PRIX : 250 »

DIMENSIONS
Les mêmes que celles de la baignoire N° 7, page 24

Fig. 41

A robinetterie complète sur le bord et système siphoïde en bout. PRIX : 280 »

DIMENSIONS
Les mêmes que celles de la baignoire N° 7, page 24

Nos émaux étant sans plomb sont garantis pour bains sulfureux

— 25 —

Old advertisement for a bathtub model, Dupont & Cie.

of study. In the 1920s, he drew multiple nudes of his companion, Marthe, reclining in her bathtub, combining the modern ritual of a woman enjoying time in her bath with the ancient ritual of a body embalmed in a sarcophagus to defy the passage of time. More trivially, in 1840, the prefect of Nièvre was the only one in the entire department to have a bathtub, and a century later, in 1954, not much had changed: only one in ten households had a bathtub or a shower.

However, these new fixtures—the sink, bidet, bathtub, and "water closet" (W.C.)—eventually became more accessible with the post-war economic boom. Historian Jean-Pierre Goubert notes that "gestures performed in public, particularly those related to laundry and defecation, were rejected as belonging to a bygone, even somewhat barbaric past. The landscape of housing evolved. Rooms became specialized, and uses were privatized. Modern comfort settled in, along with an entirely new way of living." In a 2010 study entitled "Toilet and Bathroom in France at the Turn of the Century," Monique Eleb analyzed the transformation of the toilet cabinet, which was more focused on beauty and vanity, into the bathroom, a space that "is not defined as masculine or feminine and allows men to access cleanliness in a space less symbolically feminine than the toilet cabinet."[33]

The 1950s marked a real turning point. In 1951, Françoise Giroud, then the director of *Elle* magazine, commissioned a comprehensive study on the cleanliness of the French, but the article's title only focused on women: "Is the French Woman Clean?" The response was "no," documented by "distressing results" that caused quite a stir even at that time. Toothbrushes, changing or not changing underwear, soap usage—everything was scrutinized. With a touch of sexism that was characteristic of the time, Françoise Giroud took the opportunity to criticize vanity, which continued to overshadow basic hygiene and prevented women from wanting to be clean—the proof being that men, being less concerned with vanity, were supposedly cleaner. A year later, *Paris Match* presented its ideal home. The magazine stated that "water and order are the true luxuries of modern life." This conclusion was in line with modernist architects Auguste Perret and Le Corbusier,

33 — ELEB, Monique. "La mise au propre en architecture. Toilette et salle de bains en France au tournant du siècle (1880-1914)". *Technique & Culture*, no. 54-55 (January-June 2010).

Baths and showers laundry facility, Paul Bert (Lyon), 1935.

The influence of the CGE extended far beyond providing a mere convenience, it contributed to redefining the modern relationship with both the interior and the exterior.

as they placed hygienic concerns at the center of their work: air circulation, access to water and sanitation, the need for light, space optimization, decluttering rooms, and the importance of outdoor spaces—all concepts that were brought to the forefront during the Covid crisis.

The democratization of the bathroom gradually occurred in the post-World War II era, thanks to the construction of new modern homes. Symbolically, it was not until the 1970s that the last public bathhouses built in the nineteenth century, such as the building in the Marais district in Paris (which later became a famous nightclub) or those in Pontoise (abandoned in the 1980s and converted into offices for a local newspaper in 1993), were closed. Today, municipal public showers still exist for the most disadvantaged, but to preserve the new requirement for privacy, they take the form of individual cabins.

During the postwar economic boom, the rate of households equipped with appliances also skyrocketed (from 8 percent in 1954 to 44 percent in 1967 for washing machines alone), much to the dismay of certain nostalgics, such as Louis Aragon, who denounced the United States as a "civilization of bathtubs and refrigerators," or Boris Vian, who lamented the fact that courtship now involved offering not one's heart but "a refrigerator, a nice scooter, an atomizer, and Dunlopillo bedding." With these modern appliances, from washing machines to dishwashers, which operated on cheaper and more efficient energy, women did not achieve equality in the division of household chores but did gain time in their daily lives—a small step toward emancipation.

Guy Burette, President of the Vexin Normand Water Union, recalls his childhood in Buchy, Seine-Maritime: "I still remember my mother filling a large pot with water to do the laundry; it took so much time! It used to take more than a day to do what now takes two or three hours because we had to boil the water to make it whiter, soak, dry, iron... People have forgotten all that." Thus, the average water consumption per person gradually multiplied by ten, from twenty to two hundred liters per day. This was the era of abundance.

The widespread access to clean water had consequences beyond the home. Although the idea of combating alcoholism at school may seem surprising today, it should be recalled that it was in the same decade, 1956, that a circular issued by Pierre Mendès-France put an end to the presence of alcohol in school cafeterias for children under fourteen! In line with the nineteenth century—when even Pasteur himself wrote in 1866 that "wine is the most hygienic of beverages"—there was still so much mistrust of available water that people primarily consumed wine at the table (and midwives sometimes performed deliveries without necessarily washing their hands). It was the distribution of an adequate quantity and quality of drinking water that brought about this transformation of our behavior toward a form of sobriety.

The influence of the Compagnie Générale des Eaux and the entire water supply sector along with it extended far beyond providing a mere convenience; it contributed to redefining the modern relationship with both the interior and the exterior. As sociologist Clément Rivière states, since 1945, "the uses of public spaces have undergone profound transformations: with water and electricity supply networks, the advent of refrigerators, washing machines, and televisions, it became possible and enjoyable to spend more time at home. There was no longer any need to go to the public square to wash one's laundry, for example."[34] Long before the emergence of smartphones or the quest to optimize time, the increasing presence of cars in cities, or the evolving norms of good parenting, water helped to shape our children into "indoor children," to borrow a phrase from Dutch geographers Lia Karsten and Willem van Vliet. Some now call for a reversal of this trend to reclaim the outdoors—making urban spaces more welcoming and safe, connecting green spaces, rethinking intersections, managing car traffic, and prioritizing pedestrians. According to sociologist Thierry Paquot, "an entire culture of civil engineering needs to be rethought!"[35]

34 — RIVIÈRE, Clément. Interview by Clara Georges, "Où sont passés les enfants des villes". *Le Monde*, July 14, 2022.

35 — PAQUOT, Thierry. Interview by Clara Georges, "Où sont passés les enfants des villes ?". *Le Monde*, July 14, 2022.

From Invisible Water to Rare Water

Despite its major consequences for our way of life, it is clear that society as a whole seems to have amnesia when it comes to water: whether it is simply about its source (who knows where the water they drink comes from?), its price (who knows the amount of their water bill?), or its quality (who can say what the water flowing from their tap is composed of and what standards define its potability?). While water used to be tangible, organic, and foundational, our relationship with water has evolved in a few decades to a high level of abstraction that "invisibilizes" both the water network (pipes, pumps, and treatment plants) and the territory it manages. Even the names of French departments, almost all of which are named after a river or stream, are now only described by their number in common language, a sign of a new attachment that is more administrative than geographical. By hiding water, by treating it far from home (upstream or downstream), we have domesticated it. But in the process, we have made the awareness of its fragility less acute. Today, there are many points of ignorance among the general public regarding water management. This can be seen by reading the national water barometer published every year for the past twenty-six years by the Water Information Center (CIEAU). In 2022, for example, 77 percent of people believe that water is drinkable in its natural state. The real function of wastewater treatment is known by less than a third of French people, and two-thirds of French people are unaware of the price of a cubic meter of water. Many of them feel that they spend more on water than on the internet and telephone when, in reality, water is two to three times cheaper.

This lack of knowledge has been particularly supported by CNRS researcher Agathe Euzen, who in 2007 studied perceptions regarding water quality and health risks. She found that the definition of good water evolves with time and sensibilities, but also that ignorance of health standards leads to risky or at least paradoxical behaviors. For example, one condominium refused to change lead pipes because it downplayed the risk involved while "disengaging from any responsibility by adopting individual alternative solutions using filtering pitchers." Similarly, Parisians, who were the subject of her study, rarely make the connection between limestone and calcium, even though the former contains the latter. One interviewed user said, "In tap water, there is limestone; it is less rich than mineral water." However, this limestone is composed of calcium carbonate, exactly like some mineral waters, which could also cause scale buildup in household appliances if they were used in kettles or washing machines. From limestone to calcium, there is only a lexical step that consumers dare not take, convinced that one is harmful while the other is beneficial.

It was in the 1990s that consumers began to gather in associations and the media started to take an interest in issues such as water quality or network efficiency (and therefore leaks). The French portmanteau *consom'acteur* (consumer-actor) appeared to describe the committed forms of consumption that result from ecological awareness.

Géraldine Sénemaud, consumer director of the Water France activity at Veolia, says that, as a result of individualized behaviors and increased consumer demands, customer relations have become paramount in the ecosystem of water distributors. "For a long time, the only contact between the user and the distributor took place when they subscribed and terminated their contract, or when a billing problem arose. Today, the customer does not have a relationship of simple convenience with water; they are aware that it needs to be protected."

On the customer relations front, the relationship with the user now passes through a permanent link, via call centers modeled on those set up by telecommunications operators in the 1990s. "It has become a know-how," says Sénemaud. "The customer experience has become paramount." Water distributors now assert themselves as a local service, with small local agencies in the hearts of cities

Our relationship with water has evolved in a few decades to a high level of abstraction that "invisibilizes" both the water network and the territory it manages.

© Tobias Aeppli

and permanent offices on market days—and the teams responsible for consumers regain the central role they originally had when it came to contracting the first subscriptions.

On the water quality front, to meet the demand of dissatisfied consumers who see their pipes or domestic appliances damaged, Veolia's expertise, for example, was solicited in the Normandy Vexin to build water decarbonation plants and reduce the limestone content. "These are big investments," explains Guy Burette, "but it also allows us to protect the groundwater, because limestone encourages people to use more detergent and softeners, which pollute downstream."

On the equity front, the implementation of the Brottes law in France in 2013 accelerated the deployment of the solidarity water voucher and, more broadly, social tariffing—in addition to ongoing efforts to raise awareness about tap water use, especially among disadvantaged populations who, coming from countries where water is not drinkable, may still prefer to buy bottled water, even for hygiene or cooking purposes, at the expense of their purchasing power.

Finally, on the consumption control front, new personalized services are emerging, based on the introduction of remote meter reading in the early 2000s, well before it was deployed for energy. These new meters allow for almost perfect transparency with the consumer, as well as for real-time billing, capable of alerting the user to their consumption or potential leaks. In 2022, for example, consumers were informed of more than seventy thousand leaks, saving 4.2 million cubic meters of water (equivalent to 1,700 Olympic-sized swimming pools). Xavier Mathieu, CEO of Birdz, a Veolia subsidiary specializing in the digitalization of water professions, believes that data science will make cities smarter, in France and around the world. "Soon, we will even be able to predict tomorrow's consumption volumes or analyze population flows, as water consumption is the best indicator of human presence in a region," he says. "This information has real value for waste collection. For example, we will be able to determine whether additional trucks need to be dispatched based on the situation."

As has long been the case, Veolia is developing new services to meet emerging needs—services whose usage is gaining importance over time, with new needs being added to the initial ones: remote reading, initially invented to meet the needs of individualization, shows its usefulness in an era of water scarcity.

Because the era of water scarcity is now: since the late 2010s, episodes of drought and climate disasters have changed mentalities much faster than years of scientific education, and more and more people in France and elsewhere are realizing that water is scarce. As seen in California for several years, customers are now hunting for water waste. They question the irrigation of crops during heatwaves, swimming pool water, golf course irrigation, and the artificial snow at ski resorts. Sandrine Motte, director of Eaux de Marseille, sees attitudes changing in the city: "Just five years ago, the street cleaners would open the hydrants to clean the sidewalks in the middle of summer, letting the water flow into the gutters," she says. "Today, these hydrants are closed. And when people see practices like street

pooling—opening fire hydrants to cool off during heat waves—they send us indignant messages on social media. These ways of doing things are no longer acceptable."

Concern about water shortages among the French population jumped from 32 percent in 1996[36] to 81 percent in 2023,[37] an increase of nearly fifty points. More broadly, 71 percent of the world's inhabitants feel exposed to risks related to climate change or pollution, and 60 percent are willing to accept most of the changes (economic, cultural, and social) that will come with the massive deployment of ecological solutions.[38]

The current movement therefore reflects a strong desire in response to a heightened awareness. Spain has taken the lead in water conservation: in Barcelona, for example, consumption decreased by an additional 20 percent after the intense drought of 2000. As in the rest of Spain, average consumption now stands at one hundred liters per day per person, 20 percent less than in France.

The current evolution goes beyond the initial movements of optimization and performance initiated since the 1990s. Indeed, since that decade, network efficiency has increased to reach 80 percent in France, and private consumption has decreased by 30 percent due to remote reading, awareness campaigns, and, importantly, the reduced consumption of household appliances, from dual-flush toilets to energy-efficient washing machines.

In all cases, rather than an approach centered on the individual, sobriety is best integrated into a comprehensive territorial approach, adapted to the specificities of the resource and its local uses. This is the approach that the European metropolis of Lille has taken by committing to the most ambitious sobriety contract in Europe at a time when water scarcity is now hindering its industrial development. This will involve removing degressivity (the progressive reduction of payments above a certain level) for major consumers, distributing hydro-efficient kits, and tracking and repairing diffuse leaks under sidewalks and roads. And, importantly, Veolia will incur penalties if it sells more water than planned.

Other models may exist, such as the use of incentive pricing for consumers or the development of more decentralized systems, including rainwater harvesting or the recycling of wastewater for toilets and gardens. These perspectives raise a wide range of questions: if exiting the network seems to be reserved for only a small fraction of the population, what is the optimal balance between autonomy and the network, between an individualistic model and a solidarity model where everyone contributes equitably to the maintenance of a service accessible to all? According to researcher Jérôme Denis, the idea of completely leaving the networks is mostly a myth. "We believe in a return to ancient practices, as if we had experienced a mere consumerist parenthesis, with the constant renewal of objects and the formation of networks. With this thinking, which produces an individualizing relationship between objects and people, one can fall into a survivalist fantasy. However, when we delve into the field of maintenance, we understand that all of this is so costly that we need others: it is interdependence that governs our way of life." ●

Concern about water shortage among the French population has jumped from 32 percent in 1996 to 81 percent in 2023, an increase of nearly fifty points.

36 — Water Information Center (1996). "Les Français et l'eau".

37 — Elabe, *Les Echos* and Institut Montaigne (2023). "Les Français, l'eau et la sécheresse".

38 — Elabe and Veolia (2022). *Ecological Transformation Barometer*.

ECUADOR

Water for All in Guayaquil

Veolia's commitment to the effective right to water is evident in all the geographic areas where the group operates. In Guayaquil, the largest city in Ecuador, access to water has increased by 60 percent in ten years, reaching a rate comparable to that recorded in the most advanced countries: 97 percent of the population has daily access to safe drinking water.

To achieve this, beyond the deployment and maintenance of infrastructure, the development program has implemented a social tariff for the most disadvantaged neighborhoods. It is a debt relief program managed in collaboration with the government and local citizen associations, with a mediation process to address user complaints and propose fair payment solutions adapted to each family's conditions. As part of this program, Veolia's teams rely on a network of over one thousand community leaders to assist residents in disadvantaged neighborhoods. Four mobile agencies travel across the city to interact with residents and establish a close relationship with public services. Finally, Veolia conducts awareness campaigns each year, which promote responsible consumption, the price of water services, and resource preservation ●

MOROCCO

In Tangier with Esther Duflo, Nobel Laureate in Economics

"Economic policy issues often involve a significant plumbing component."

Esther Duflo, Nobel laureate in economics in 2019, holds the Poverty and Public Policy Chair at the Collège de France. During her inaugural lecture, she shared the results of her collaboration with the Moroccan government and Veolia to ensure the effective right to water. This demonstrates the need to align major policy directions, procedural establishment, and the attention to detail that lies at the core of her work. She also highlights the crucial role of Veolia's teams alongside the residents:

"Economic policy issues often involve a significant plumbing component. [...] A project in Morocco, directly related to plumbing, illustrates the gains from collaboration [between policymakers, engineers, and detail-oriented economists]. The Moroccan government aimed to provide water access to the poorest households. To achieve this, they had designed their program in broad outlines: companies wishing to operate water and sanitation networks in major cities had to commit to carrying out the necessary work to ensure access for poor households.

"Veolia, which had won the tender for Tangier, completed major construction projects to bring water and sanitation to the narrow streets of the old city center. They also devised a free access subscription: the cost of individual connections was included in a zero-interest loan, repaid monthly along with

the water bill. Everything was in place: the political will, the work of civil engineers, and the financial arrangement. But the customers did not come! The demand for connections was very low. It was at this point that I met Olivier Gilbert from Veolia. He was interested in this enigma, and I was interested in the potential impact of access to safe drinking water on the lives and health of residents. We started working together.

"The Veolia team had ideas about the barriers preventing households from applying for connections: conflicts between property owners and tenants, lack of funds, conflicts within extended families. But as we walked around the city and interviewed residents, we discovered another barrier: the application process, as is often the case for government programs worldwide, was complicated. Every connection applicant had to appear in person at an administrative center, quite far from their homes, with a pile of documents; if any document was missing, they had to come back. The procedure was too complex, and most residents had simply given up.

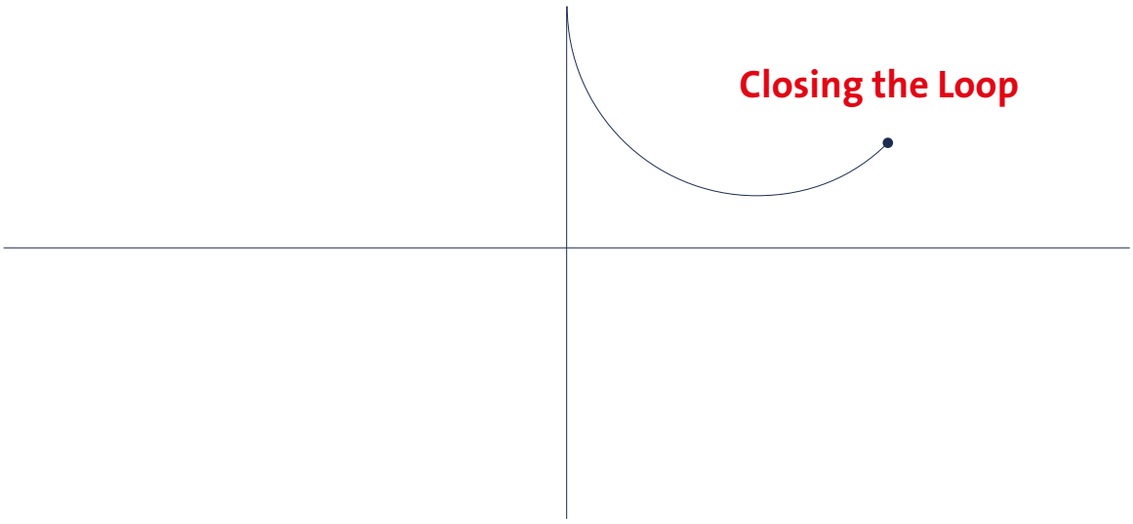
"This type of obstacle course for obtaining a right [...] is sometimes intentional. Imposing obstacles is a way to ensure that only those who truly need a service (or assistance) are willing to go through the process, implicitly targeting the intended beneficiaries. But most often, it is simply the byproduct of excessive surveillance efforts and officials' mistrust of their constituents. New layers of documentation and verifications are piled on top of old layers, without ever removing any.

"In the case of Tangier, the complexity of the procedure was not entirely intentional. When we proposed sending a team to visit residents at home and photograph their documents there, thus saving them multiple trips, Veolia and the government agreed. We designed an experiment where every other resident received a home visit to offer them a connection. The demand exploded, from less than 10 percent to 69 percent. The connection allowed families to free up considerable time, resulting in improved mental health and well-being and a reduction in family tensions. All of this required only a small additional expense, which made the infrastructure effort profitable."

Story
6

Recycling Wastewater

Closing the Loop



The concept of the sanitary city emerged in the mid-nineteenth century by disrupting the metabolic processes of organic societies, which relied on the spreading of human and animal waste to enrich the soil. This transformation took decades, since the material circulation was seen as positive as long as it transmitted the new pollution of the industrial and urban world to the earth. Before being technical and regulatory, the challenge of water reuse is therefore anthropological and cultural, as it involves redefining the distinction between the pure and the impure that has been established for over a century. While Victor Hugo depicted the sewers as the gold of Paris in *Les Misérables*, reused water is still waiting for its poets and philosophers. The new metabolism of water-scarce societies, which now affects countries that once seemed immune, needs to be invented by combining emotions, law, governance, and economic models •

GRÉGORY QUENET

Since John Snow's studies in London in 1854, which revealed that cholera could be transmitted through water from a contaminated fountain, and the subsequent development of water and sanitation infrastructure, people have had a symbolically linear relationship with water: on one side, we obtain clean water, and on the other side, we dispose of our impure waste.

After centuries of separating these flows, the recycling of wastewater touches upon a strong cultural issue: it aims to bring them back together in a closed loop. It invites us to abandon the fiction that dirty water simply disappears, which was possible until now because we regarded the natural environment where it was discharged as indifferent and external to ourselves as humans. Instead, wastewater recycling fully embraces the water cycle, going beyond the initial wastewater treatment processes that aim to preserve bodies of water, at a time when we are becoming aware that humans are interconnected with nature. The recycling of water reflects the cultural changes that the era of ecology invites us all to embrace.

To respond to this new cultural moment, the necessary technology is available. These innovations, known as treated wastewater reuse (TWR), have been proven effective for over forty years in countries where water scarcity is most severe. Now, as freshwater resources become increasingly scarce, their usefulness is becoming more evident. The challenge lies in their widespread deployment to meet the water needs of both humans and nature ●

From Namibia to the Rest of the World

The use of wastewater is not a new concept. In France, starting as early as the mid-nineteenth century, wastewater has been used for irrigation and fertilization of crops. However, it was only in the late twentieth century that the modern version of water recycling emerged in countries facing intense droughts: wastewater is still reused, but first it is treated to remove impurities. Namibia has become an emblematic country for treated wastewater reuse worldwide. The capital city, Windhoek, embarked on wastewater recycling in the 1970s to address severe water stress. Veolia even transforms wastewater into potable water there to ensure not a single drop of accessible water is wasted. According to Yvan Poussade, an expert in TWR at Veolia, Namibia is "a unique reference worldwide that has inspired, and continues to inspire, many countries by influencing a number of regulations." Beyond the most obvious uses, such as urban cleaning or the provision of organic fertilizers for green spaces and agriculture, these installations have proven to health authorities their technical capacity to purify wastewater to the point of making it potable again. Laurent Obadia, Deputy CEO of communication, stakeholders, and the Africa-Middle East region, says, "Namibia was at the forefront of exploring the most advanced uses from the beginning because resource tensions were most pronounced there. The fact that these uses are now being deployed elsewhere in the world is a symbol of the ability of all African countries to inspire the world."

With this expertise, Veolia has responded to emerging needs since the 1980s, contributing

to making some regions of the world highly efficient in wastewater recycling.

In Israel, almost 90 percent of wastewater is recycled for agricultural purposes. This is a necessity in a semi-arid country that faces chronic water scarcity. Jordan has also embraced wastewater recycling, with Veolia providing 25 percent of the country's agricultural water needs through the recycling of wastewater from the capital and surrounding areas at the Al-Samra wastewater treatment plant. This has allowed Jordan, despite its limited water resources, to develop its agricultural activity and feed its population. In South Africa, Veolia inaugurated a water recycling plant in Durban in 2001 to supply the industrial sector. Since then, similar projects have emerged worldwide, from Singapore to Hawaii and Australia.

In Europe, Italy developed the Nosedo plant in Milan in the 2000s, operated by Veolia, which is the largest wastewater reuse facility in Europe, irrigating over twenty-two thousand hectares of land. However, it is Spain that has been most proactive in wastewater recycling, with 15 percent of wastewater being recycled compared to 8 percent in Italy. In 2000, the Agua Plan was adopted to irrigate three hundred golf courses using recycled water. Spain requires a permit to irrigate a golf course with potable water—the opposite of France, which requires a permit to use recycled water. The Barcelona metropolitan area has been particularly active since the drought experienced in the early 2000s. In 2006, Veolia equipped one of the largest municipal wastewater recycling plants in Europe with its technology. Today, the water supplied to taps by Aigües de Barcelona combines water directly from the mountains with recycled water from wastewater treatment plants. Manuel Cermeron, General Director of Veolia Spain and General Director of Agbar, explains: "With a production capacity of over 300,000 cubic meters per day of recycled water, the Baix Llobregat plant also supplies water to farmers, various urban services such as park and garden irrigation or road cleaning, and can even supply cooling systems for certain industries." He adds, "A part of the volume is also used for environmental benefits, from wetland restoration to maintaining

Wastewater treatment plant in Windhoek, Namibia.

the flow of the Llobregat River, and another part is reinjected into groundwater to limit the intrusion of saline water and ensure the quality and quantity of freshwater resources in the region." Thus, the recycling and reuse of wastewater contribute to the water security of the metropolis.

Mature Technologies and Willing Populations, but Uneven Regulations

The technology for wastewater treatment is mature, and the treatment processes are effective. Once the water is collected at the wastewater treatment plant, it goes through several stages. Firstly, the water undergoes preliminary treatment, which removes solid waste through screening, sedimentation, and rapid filtration. Then, primary treatment is carried out to remove suspended matter through sedimentation and flocculation. The secondary treatment involves biological purification, which eliminates pollutants, biodegradable organic matter, and pathogenic microorganisms. Finally, tertiary treatment is applied to remove undesirable substances, especially for urban use. Various methods are employed, such as membrane or media filtration, chemical treatments (chlorine, bleach), or ultraviolet irradiation. The level of treatment can be adapted to the quality of the incoming water and the specific needs of the customers—depending on whether the recycled water is destined for irrigation, industry, or drinking—to ensure the best sanitary quality at the lowest environmental cost.

Citizens appear ready to accept this new relationship with water. Although it challenges established practices and the age-old distinction between the pure and the impure, it aligns with the new expectations of circularity and waste reduction, especially as the impacts of climate change make it increasingly necessary. Some statistics support this notion: 69 percent of people worldwide are willing to consume food produced with recycled water, and 66 percent are willing to use recycled water for personal hygiene.[39]

Regulations, however, still hinder the widespread adoption of water reuse, as they have been slow to reflect changing mindsets and adapt to evolving needs. This is particularly evident in agricultural use. In 2020, the European Union published regulations to govern and secure the use of treated wastewater for agricultural irrigation,

39 — Elabe and Veolia (2022). *Ecological Transformation Barometer.*

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defining four quality levels. “With level D, it is possible to irrigate short rotation coppices. Level C allows for drip irrigation, but the water cannot come into contact with the product, especially in vineyards. Quality level B permits agricultural and horticultural use if the water does not touch the products, and finally, quality level A allows for water to come into contact with the produce and be consumed raw, such as in salads,” explains Yvan Poussade. With water recycling and advances in health knowledge, the distinction between the pure and the impure becomes increasingly subtle.

Technologically, everything is in place to overcome this new frontier of water treatment in the coming years, particularly in coastal areas where it does not compete with downstream water resource uses. Moreover, it is more energy-efficient when compared to groundwater extraction and raw water treatment. This requires a strategic mixing of uses, considering agricultural, industrial, recreational, and urban safety purposes (including cleanliness, green spaces, or fire protection), as well as drinking water supply and environmental considerations (such as the recharge of groundwater or wetland preservation).

Everything is in place to overcome this new frontier of water treatment in the coming years: wastewater recycling.

Given that these considerations must be made at the local level, it is essential to ensure that the supply and demand for recycled water are well-matched. On each project, it is necessary to avoid conflicts of use and identify consumers who would benefit from recycled water. This is the challenge that Ecofilae, founded by Nicolas Condom in 2009, partially addresses. As Condom emphasizes, “We need to reach out to users, whether farmers, industrialists, or golf course owners.” It is then necessary to assess their water needs in terms of quantity and quality. The goal is to determine if these needs can align with the capabilities of the treatment plant in order to build a water reuse loop. This correspondence between supply and demand has always been at the heart of Veolia’s approach, as it was with the Compagnie Générale des Eaux in the early days.

French Tardiness

However, France is still falling behind, with less than 1 percent of wastewater being recycled, as Yvan Poussade points out. Yet, as Catherine Boutin, Alain Héduit, and Jean-Michel Helmer highlight in their report on wastewater treatment technologies for reuse, in the 1980s, France was “one of the most dynamic European countries in developing wastewater reuse for agricultural irrigation.”[40] With its reputation for innovation and the presence of pioneers such as those from the Compagnie Générale des Eaux, France seemed well-positioned to lead the way in this field. In the nineteenth century, for example, Eugène Belgrand developed an exceptional hydraulic system in Paris, consisting of a dual underground network. This unique system, supplying both potable and non-potable water, allowed buildings to be connected while serving various urban needs.

Subsequently, Veolia has been able to test and develop projects for the reuse of treated wastewater in France. Since 1995, Veolia has managed the sanitation services in Pornic, where 10 percent of the total annual volume of recycled water is used for irrigating the city’s golf course. As a result, the city has reduced its reliance on water resources while improving the quality of its bathing water.

Despite these innovative projects and the maturity of technologies and stakeholders, France is currently lagging behind. How can this be explained? According to Pierre Forgereau, Director of the Artois Douaisis Territory at Veolia, the answer is simple: countries like Israel and Spain had to contend with severe water shortages before France did. “The regulations in these countries adapted to the pressure on water resources. Until a country is in dire need of considering wastewater reuse, no one takes action.”

After experimenting with numerous innovations that have subsequently benefited the rest of the world, from governance models to water meters, France now finds itself in a position to learn from the world’s accumulated experiences.

40 — BOUTIN Catherine, HÉDUIT Alain, HELMER Jean-Michel. “Technologie d’épuration en vue d’une réutilisation des eaux usées traitées (REUT)”, 2009.

As Pierre Forgereau (Regional Director in France) predicts, "Given the current situation in France, regulations will have to evolve rapidly." Thierry Trotouin, Director of Industrial Markets at Veolia, also highlights that "to set an example in the wastewater treatment plants we manage, we use treated wastewater to prepare reagents for sludge treatment. Treated wastewater is also used for equipment cleaning." Thus, Veolia, along with many municipalities expressing the need, actively advocates for the acceleration of these new approaches in France. Progress is being made, as Pierre Ribaute, CEO of Veolia Water France, says: "France has entered a new era in its relationship with water, and the recycling of wastewater is just the tip of the iceberg. A range of solutions are now ready to be deployed to manage both the small and large water cycles."

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The Jourdain Program, an Avant-Garde Project

In 2022, a new milestone was reached in France: the authorization in Vendée, a pioneering department in wastewater recycling, for a cutting-edge European experiment in indirect transformation into drinking water. The Jourdain program was named after two references: the Jordan River that flows along the border of Israel, an example to follow in water recycling, and the character of Mr. Jourdain in Molière's play *Le Bourgeois Gentilhomme* (1670), who speaks in prose without knowing it, just as we unknowingly reuse wastewater when we draw it downstream from the river into which it was discharged.

The project is led by the public water service of Vendée Eau—with the collaboration of Veolia, which designed and operates the refining unit of the program. It is financially supported by the Loire-Bretagne Water Agency, the Pays de la Loire region, the European Regional Development Fund (FEDER), the department of Vendée, and the FNADT. Vendée Eau also works with a project management assistance team composed of CACG, Merlin Consulting, and Ecofilae. It is a collective territorial project.

Instead of being discharged into the ocean, a portion of the water leaving the wastewater treatment plant in Les Sables d'Olonne is recovered and treated again at a refining station. This station treats pharmaceutical residues, micropollutants, and microbiological components such as viruses and bacteria. The resulting water is then transported twenty-seven kilometers to the Jaunay dam, where it is reinjected into a vegetated area. "A battery of tests will be carried out on living organisms, fish, and shellfish found in the water. To analyze this biotope and measure the quality of the discharge, eight hundred components will be thoroughly examined," explains Jacky Dallet, president of Vendée

Eau and mayor of the municipality of Saint-André-Goule-d'Oie.

In the region of Saint-André-Goule-d'Oie, treated water will be mixed with the river water, which then flows to the drinking water production plant that will produce consumable water for households. The department of Vendée, particularly vulnerable to episodes of drought, has the unique trait of drawing 94 percent of its drinking water from surface waters, whereas the national average is 30 percent. "A prospective consumption study for 2030–2035 highlights areas of vulnerability throughout the department and the coastal region. This could represent a deficit of eight million cubic meters of water," Dallet says. The Jourdain project therefore represents an opportunity to preserve the natural resources and secure the drinking water reserves of the department. The stakes are significant: by 2027, the system could produce two million cubic meters of water annually.

Through the Jourdain program, Vendée Eau has a mission: to demonstrate the effects of an indirect reuse system of treated wastewater for drinking water. "The ultimate goal is to contribute to the evolution of regulations, to participate in improving the state of the art of water reuse, and to eventually enable the replication of similar solutions in France and Europe in territories sensitive to water resource pressure," Dallet says.

This is another way of closing the loop: after France, as part of the first European industrial revolution, developed expertise in water-related professions that could benefit the rest of the world, it has now become a beneficiary of techniques developed elsewhere. It also demonstrates the usefulness of a global group in addressing ecological challenges, capable of capitalizing on expertise developed by those who were the first to be exposed to any particular issue.

Through the Jourdain program, Vendée Eau has a mission: to demonstrate the effects of an indirect reuse system of treated wastewater for drinking water.

From this global vision of water issues emerges a clear hierarchy of actions to be deployed in the coming world. "There is now a range of solutions: first, consume less, then reduce network losses, and finally develop new resources," says Estelle Brachlianoff, CEO of Veolia. Water conservation, which involves a collective paradigm shift, emerges as the first solution, followed by efficiency and mobilization of best practices in the field, then the development of alternative solutions, from nature-based solutions to desalination and water recycling. This is a range on which the group will continue to innovate to ensure the best adaptation for each region ●

MOROCCO

Industrial Water Recycling in Tangier

Veolia, through its subsidiary Veim, is assisting the Renault factory in Tangier, Morocco, in reducing its environmental footprint to achieve zero industrial liquid discharge. The Tangier factory, opened in 2012, has reduced its water intake for industrial processes by 70 percent compared to an equivalent factory in terms of production capacity.

These results are achieved through optimizing industrial processes to minimize water requirements and corresponding discharges. Several treatment steps are employed to transform effluents into purified water. This water, meeting stringent process quality requirements, is then reused in surface treatment and vehicle assembly processes.

In total, 437,000 cubic meters of water is preserved annually, equivalent to 175 Olympic-size swimming pools. Water reuse is not the only technology contributing to this achievement, but it plays a central role

SPAIN

Alicante's Objective : 100 Percent Water Recycling

Located in Spain's Valencia region, Alicante is a prominent destination for tourism and with its citrus fruit contributes to making Spain the "orchard of Europe." Like many others, the region now faces climate change, rising temperatures, torrential rains, and droughts. In this disrupted context, "the city must become a water supply center," says Jorge Olcina Cantos, a geographer and climate specialist at the University of Alicante, and even potentially "the food supply center for agricultural areas."[1] This transformation began with wastewater recycling.

In 2015, a floodable urban park, Parc de la Marjal, was created to retain water during heavy rainfall while providing a cool and biodiverse space. It supplies the city's water network, operated by Aguas de Alicante, a joint venture between the city of Alicante and Veolia, and contributes to achieving a water recycling rate of 33 percent by 2023.

Similar to Los Angeles, the territory aims for 100 percent water recycling, with no freshwater being discharged into the sea. The plan to achieve this goal includes the creation of four additional floodable parks with a capacity of ninety thousand cubic meters by 2027—twice the capacity of Marjal. Additionally, the network of reused wastewater, complementing the existing seventy-kilometer drinking water network, will be expanded. While agriculture has suffered from reduced precipitation in the past, mandarin producers attest that through the reuse of wastewater, they have been able to reclaim abandoned agricultural land. By pursuing its ambitions, the territory believes it can sustainably protect itself from climate uncertainties ●

1 — PALIERSE, Christophe. "Stockage, recyclage, dessalement : les villes espagnoles en pleine guerre de l'eau". *Les Echos*, July 2, 2023.

KOREA

The Electronics Industry in Korea: From Water Recycling to Ultrapure Water

The production of chips and semiconductors requires ultrapure water that meets very strict quality standards. In the microelectronics industry, water is used to clean wafers, which are extremely sensitive to contamination by impurities. Since March 2001, Veolia has been providing SK Hynix, the South Korean semiconductor leader, with consistently high-quality ultrapure water, an essential element for its high-tech production. The company also ensures the treatment of wastewater to guarantee water supply security. This is currently Veolia's largest industrial water project, with a capacity for treating nearly one hundred thousand cubic meters of ultrapure water per day, and over three million cubic meters of reused water per year.

Its mission is to treat the water to remove all organic or chemical elements and come as close as possible to a liquid containing nothing but H_2O. The water is then continuously supplied at a constant temperature to the electronic hardware production site. Finally, the water is treated again and reinjected into the process.

By regularly auditing and analyzing all wastewater reuse facilities and implementing the most innovative solutions and technologies, Veolia not only secures the supply of ultrapure water but also continuously improves the treatment of SK Hynix's effluents at its three sites (Incheon, Cheongju, and Gumi). As a result, over 40 percent of the wastewater is reused on-site, significantly reducing SK Hynix's operating costs, improving production yields, and surpassing sustainability targets. The treatment and recycling of these effluents to stricter standards than required by South Korean regulations also play a major role in environmental protection ●

EMPLOYEE'S TESTIMONY

Luc Zeller

Employed at Veolia since 1983

TAIWAN

Luc Zeller, who leads Veolia's Taiwan business unit, is celebrating his fortieth anniversary with the company. He started his journey in Groupe Montenay, specializing in energy, which was acquired in 1986 by Compagnie Générale des Eaux, now known as Veolia. His career path was shaped by the group's international expansion: after ten years in the Rhône-Alpes region, he spent five years in the Czech Republic and then twenty-five years in Asia, where he now leads the Taiwan Business Unit. Being locally established, he has witnessed the transformation of multiple regions: the opening of Eastern Europe after the fall of the Berlin Wall and the economic explosion of China with growth rates exceeding 10 percent. He has also worked in India and Egypt.

"I am fully convinced that if you trust your employees and define the rules of the game clearly, you have tremendous potential," he says. "Success is never individual, but always collective." Below are some excerpts from an interview with Zeller:

In your forty-year career, how have you seen Veolia evolve, especially in the water sector?

"Today, more than ever, we are leveraging our innovative capabilities in ecological transformation. We are responsible and proactive with public authorities and the communities we serve, and this has significantly strengthened since the merger with Suez, particularly in terms of geographical reach.

"We have developed partnerships for effective and responsible water management, as well as advanced technologies to prevent pollution and reuse water resources. Good management also involves our teams' actions to provide responsible chemicals and contribute to the selection of pumps that ensure competitive pricing of the water sold to our customers through reduced electricity consumption and maintenance."

"Our history opens doors for us; it gives us the trust of being a solid, resilient company built on strong foundations.

What is the synergy between the different business areas of the group?

"The combination of our three business areas is unique in this market. Today, with the challenges of reducing carbon footprint, it makes perfect sense. In the facilities we operate, we already involve all three business areas. Let's take the example of the semiconductor industry in Taiwan. It faces significant global demand and needs to reduce water consumption without impacting household consumption. Clients in this industry, such as Apple, also encourage them to further decarbonize their production. Therefore, a project for a wastewater recycling plant to produce ultrapure water for semiconductor manufacturing will also integrate the recovery of materials for revalorization and the use of renewable energy."

How is Veolia's long history an asset?

"In China, the notion of history is highly valued. Veolia, with its 170 years, is considered wise, especially when the most prestigious Chinese universities are younger than Veolia: Tsinghua Beijing, equivalent to the Polytechnique, was founded in 1911. Our history opens doors for us; it gives us the trust of being a solid, resilient company built on strong foundations. However, we should not rest on our laurels! We must remain competitive, agile, and innovative. We have the means to achieve our ambitions and a clear objective. I am optimistic!"

WASTE

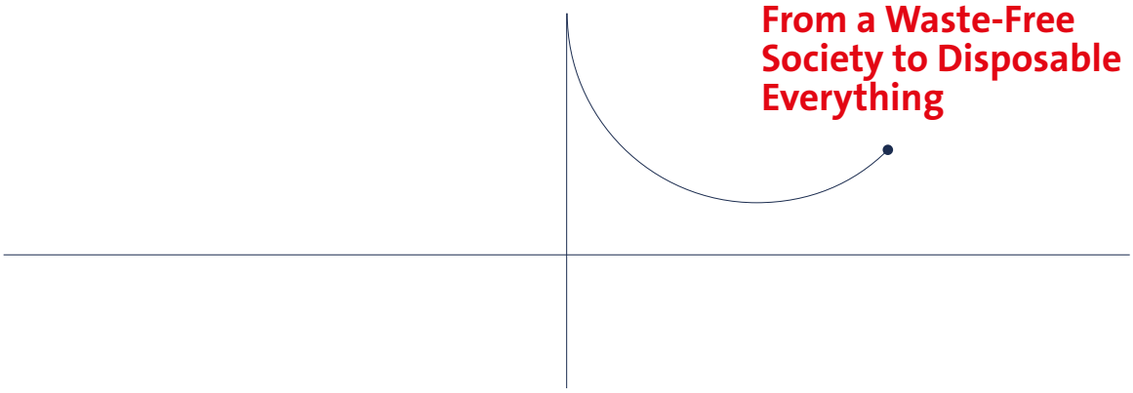
CHAPTER 2

Was waste “invented” in the twentieth century? In any case, it has not always taken on the face that we know today. The waste we see now comes from consumer society, the petrochemical industry, and exponential economic growth in both wealthy and emerging countries. The history of waste is a story of the slow realization of a global ecological problem, initially treated with a form of carelessness or ignorance, and then tackled head-on by authorities and businesses. In the era of ecological transformation, Veolia no longer “treats” waste but “valorizes a product”: recycling materials, producing energy, fertilizing soils, and more. It marks the beginning of another story •

Story
7

Inventing Waste

From a Waste-Free Society to Disposable Everything



The rise of private waste collection and disposal sectors marks a major anthropological shift in all industrialized countries from the late nineteenth century onwards. Previously, human products were constantly reused, but during the 1800s they began to be discarded in massive quantities, becoming what we now know as waste—in vast quantities that needed to be collected and removed from the sight of those who produced them. The idyllic vision of a pre-waste world must be nuanced with the older term of "ordure," which signifies the combination of bodily fluids and excrement that contaminate but also constitute the essence of territorial ownership, according to philosopher Michel Serres. Waste emerged when refuse was no longer seen as a resource integrated into the grand cycle of the urban metabolism—albeit something that collected in European streets in a manner that would be intolerable today. In eighteenth-century Rouen, for instance, the auction system allowed for the collection of barely three hundred grams of waste per day per inhabitant, while Paris, Europe's second-largest city in 1780, was inundated by a black, nauseating sludge that stained clothes. This sludge was a mixture of construction site residue, incineration byproducts from chimneys, and leaks from cesspools. Collected at the foot of the Île de la Cité and Notre Dame, it was dumped into muddy streets integrated into the urban fabric, alongside Les Invalides and the École Militaire, contributing to the city's pestilence. This was accompanied by the smoke from cooking tripe, the stench of suet melters, the putridity of stagnant water used by laundresses, and the miasma from tanneries and slaughterhouses •

GRÉGORY QUENET

Were waste and garbage invented? This is the thesis brilliantly defended by urban planning researcher and teacher Sabine Barles in her book, *The Invention of Urban Waste: France, 1790–1970*.[41] The author refers to "urban" waste, and the adjective is crucial. The meaning of "waste" depends on how it is understood, as definitions of this term, as well as other words used throughout history to describe the byproducts of human activity (such as sludge, refuse, filth, residues, and sewage) have reflected different visions, eras, and ways of life. According to Christian Duquennoi, an engineer at the École des Ponts and researcher at Irstea (the National Research Institute of Science and Technology for the Environment and Agriculture), the concept of waste refers to "matter that no longer has utility or function, but it does not exist in absolute terms." In his book, *Waste: From the Big Bang to the Present Day*, he traces the origin of this concept back hundreds of millions of years after the Big Bang[42] and the creation of the universe when planetary systems formed and expelled "waste," which consisted of matter and energy that were not useful for the functioning of these stars.

Within Earth's ecosystems, the undesirable products expelled by living organisms are not lost to everyone. The waste from some organisms becomes food for others, as exemplified by the carbon dioxide we exhale, which promotes plant growth through photosynthesis. "This is the beginning of the circular economy!" notes Christian Duquennoi mischievously. In a more prosaic sense, the French word "déchet" comes from "déchoir," which describes what falls to the ground during human activity: wood chips produced from tree trimming, pieces of fabric that fall after use, excrement returning to the earth, etc. Waste serves as the raw material for archaeologists, who work with what was considered useless by preliterate societies. However, for most of human history, most byproducts were reused. It was only in the twentieth century that Antoine Compagnon, a member of the Académie française and author of *The Ragpickers of Paris*, identified this period as a "parenthesis" in history—a time of disposability and widespread waste. It was during this period that solutions had to be found to transport and manage the countless amounts of waste now being produced ●

41 — BARLES Sabine. *L'Invention des déchets urbains. France : 1790-1970*. Seyssel : Éditions Champ Vallon, 2005.

42 — DUQUENNOI Christian. *Waste, du big bang à nos jours*. Paris : Éditions Quae, 2015.

The Nineteenth Century: The Valorization of Waste as a Necessity

Historians and archaeologists have relatively well-documented waste management practices from the Middle Ages and the Ancien Régime. From the moment of sedentarization, agriculture, and animal husbandry, it can be observed that waste began to be expelled from homes—as Yuval Noah Harari teaches us in *Sapiens*, dogs, "man's best friend," were originally wolves that came to the outskirts of villages to feed on garbage before being domesticated by humans. However, as Marc Conesa and Nicolas Poirier, teachers and researchers in the humanities, note, these waste materials "pursued another career."[43] During this era, almost nothing was lost; everything was transformed. Animal excrement provided fertilizer for market gardeners, all meat was consumed, skin was used to make leather, fat was reused for soap and lighting, and crushed bones were reused as glue in proto-industrial applications. According to Marc Conesa, waste management and its associated nuisances were concerns for certain communities, but population growth and the need for fertilizer found an outlet in the fields, to the extent that "waste management shaped agrarian structures and territories." The nineteenth century merely gave quasi-industrial dimensions to ancient waste recovery activities due to increased demand and technological advancements. Modern societies discovered virtues in waste while simultaneously finding it repugnant for hygienic reasons.

According to Sabine Barles, who employs the concept of "urban metabolism" in her book, the city, industry, and agriculture smoothed out the exchange of materials in the nineteenth century in order to valorize them. In summary, "the circulation of materials from homes to streets, from cesspits to factories or fields contributed to the initial rise of urban consumption. Scientists, industrialists, and farmers viewed the city as a mine of raw materials and, alongside municipal administrations, technical services, and ragpickers, worked toward an urban project aimed at leaving nothing to waste."

The symbolic embodiment of this vision is the ragpicker—including the female ragpicker, who, to do her justice, represented a third of the Parisian

43 — CONESA, Marc, POIRIER Nicolas. "Fumiers ! Ordures ! Gestion et usage des déchets dans les campagnes de l'Occident médiéval et moderne". *Revue belge de philosophie et d'histoire*, no. 98, 2020.

A ragpicker (engraving)

ragpicking workforce.[44] A well-known figure of the nineteenth century, depicted in engravings by Daumier, Gavarni, and Traviès and in an allegory of the poet for Baudelaire, the ragpicker is also described by Frédéric Le Play in a detailed chapter of his sociological study on workers.[45] Le Play outlines the budget of an exemplary ragpicker. In an exclusive interview, Antoine Compagnon reminds us that "they themselves called themselves 'small industrialists.' They were independent workers, like today's self-employed entrepreneurs. They said they didn't want bosses, but this independence was often linked to alcoholism, which prevented them from having regular employment. However, there are cases of ragpickers who became paper manufacturers and made a fortune."

If ragpickers were able to make a living from their work, it is because the demand for rags had exploded across Europe to the extent that their exportation was prohibited in France from 1771 onwards. Rags were used to make paper, which saw increasing use throughout the eighteenth century. The rise of the press, the printing boom, and the democratization of education led to a significant increase in paper production, from 18,000 tons in 1812 to 350,000 tons in 1900. It required 1.5 kilograms of rags to produce 1 kilogram of paper, making up half of the manufacturing cost. There was even a rag market with prices that varied depending on quality, often unrelated to the original material's price, whether it be cotton, hemp, or linen. (Wool rags were not used for paper production but rather for making new clothing.) Ragpickers sorted everything they collected, including bones (they were called "rag and bone men" in England), which would be turned into buttons or phosphorus for matches. They would then sell their cargo to wholesalers, known as "master ragpickers," most of whom were located on the Rue Mouffetard in Paris. These ragpickers served as agents of order, possessing knowledge of the neighborhood through their work and providing information to the police. They had a mysterious presence, wandering the streets at night with hooks and sacks full of rags, sometimes intoxicated and always dirty. Ragpickers were registered at the prefecture of police and awarded "chiffon medals," although there were many undocumented, clandestine ragpickers. Their numbers dramatically increased during the nineteenth century, reaching 200,000 in the Seine department in 1884, according to the Chamber of the Ragpickers' Syndicate.

The *vidangeur* was the counterpart of the ragpicker, responsible for another significant recovery activity of the time: the collection of *vidanges*, or excrement dumped into cesspits and later moved to open-air dumps. With a 40 percent population growth throughout the eighteenth century, France became a demographic giant. Agricultural areas expanded, leading to a veritable "hunt for fertilizers," as noted by Sabine Barles. The demand was so high that farmers and entrepreneurs were willing to pay for the right to transport urban excrement to rural areas. This was exemplified by Bridet, a Norman farmer who, in 1787, purchased the right to exploit the famous Montfaucon dumpsite in Paris,[46] now the location of Parc des Buttes-Chaumont. He patented a process to transform the fecal matter into dried *poudrette*, serving as natural fertilizer for farmers. New patents emerged throughout the nineteenth century, resulting in numerous poudrette factories that supplied suburban cities and rural villages until the twentieth century. However, criticism grew regarding the quality of this human-origin fertilizer.

To these sources of fertilizer, one must also add "urban sludge," which consisted of household waste dumped in the streets mixed with sand, soil, and various other materials (including horse excrement, with Paris having eighty thousand horses in 1900). At one point, urban sludge was directly collected by servants sent by farmers, who provided them with horses, carts, and tools; it then became a competitive market among resellers. For large cities like Paris, the interest in sludge valorization was also driven by hygiene concerns, as those who wanted to sell it had to clean it from the streets.

"Ragpickers were independent workers, like today's self-employed entrepreneurs."

Antoine Compagnon, member of the Académie française.

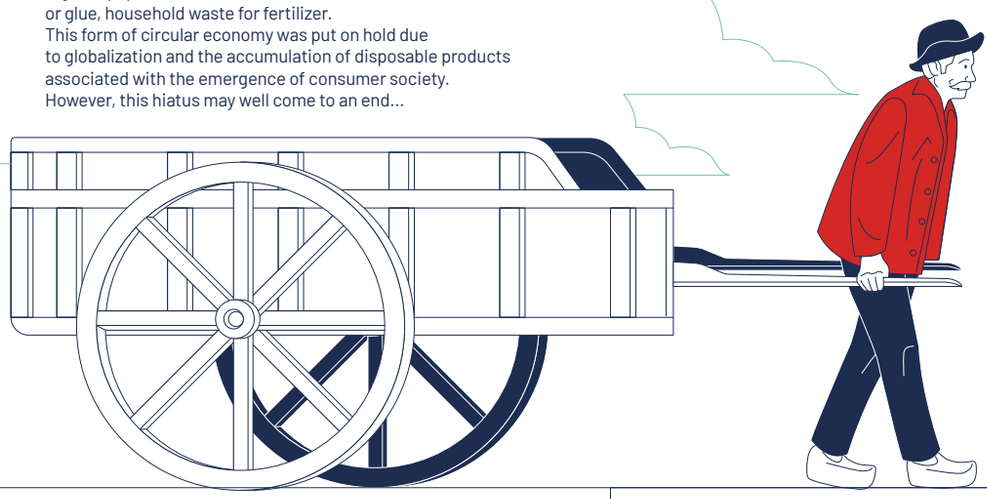
44 — COMPAGNON Antoine. *Les Chiffonniers de Paris*, Paris : Gallimard, 2017.

45 — LE PLAY Frédéric. *Les Ouvriers européens*. Paris : Hachette Bnf (2016) (Imprimerie impériale, 1855).

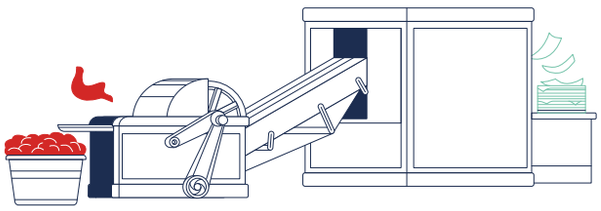
46 — A large field used as an open-air landfill, where different types of waste dried on the ground to produce fertilizer.

IN THE 19TH CENTURY,
WASTE HAD A SECOND LIFE

What happened to waste in the 19th century?
Most of it was collected by ragpickers, mudlarks, and various scavengers, finding a second life in another use.
Each waste item had one or several new purposes: rags for paper, animal skins for leather, animal fat for candles or glue, household waste for fertilizer.
This form of circular economy was put on hold due to globalization and the accumulation of disposable products associated with the emergence of consumer society.
However, this hiatus may well come to an end...

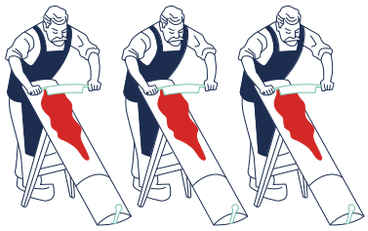


FROM RAGS TO PAPER



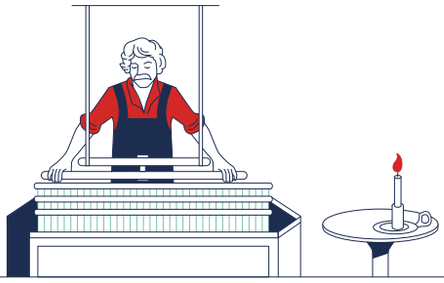
A well-known figure of the 19th century, ragpickers were independent workers who collected rags, which were in high demand at the time in Europe. And for a good reason: rags were used to make paper, which was increasingly used throughout the century. The rise of the press, the boom of printing, and then the democratization of education led to a paper production increase from 18,000 tons in 1812 to 350,000 tons in 1900, nearly 20 times more. It took 1.5 kg of rags to make 1 kg of paper.

FROM SKINS TO LEATHER



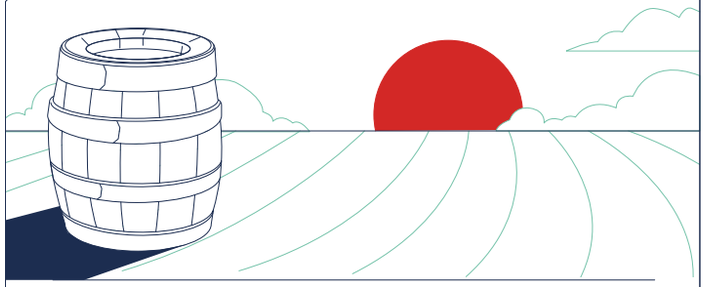
Tanning's origins date back 50,000 years, but the 19th century marked a turning point in the process: scientists discovered a chrome solution in 1840, which allowed for faster, more efficient, and less costly tanning. This type of tanning surpassed other methods of leather transformation, mainly vegetable tanning, and turned recycling into a true industry. By adding basic chromium sulfate during the process, the transformation of the leather took a maximum of 24 hours.
This was the beginning of a new era: factories would develop, and thousands of French workers would be employed in them in the second half of the 19th century.

FROM BEEF FAT TO CANDLES



In French, the profession of chandler had two different names, depending on the substance used to make the candle. The *cirier* made and sold candles produced with beeswax. A *chandelier*, on the other hand, made and sold candles produced with tallow, the substance obtained by melting animal fat from sheep or cattle.

FROM EXCREMENTS TO FERTILIZER



The *vidangeur* (waste collector) was the counterpart of the ragpicker: they collected *vidanges*, which were excrement thrown into cesspits and then moved to open dumps. With a 40% population growth throughout the century, France became a demographic giant: agricultural areas expanded, triggering a true "hunt for fertilizers." The demand was so high that farmers or entrepreneurs even paid to have the right to transport urban waste to the countryside.

The End of a Circular World: The Development of Chemistry and Hygiene

This circular process, in which the countryside fed the urban population, which, in turn, produced fertilizers for the fields and raw materials for industry, reached its peak around 1870. Several significant events gradually put an end to it over the next sixty years. "At the end of the nineteenth century," analyzes Christian Duquennoi, "the cost of primary and secondary materials became so prohibitive that an innovation race was launched to replace them with new raw materials. In a way, the invention of paper pulp, which used wood fibers instead of rags, was the first domino that set off all the others." (This led Antoine Compagnon to suggest that "the era of the ragpicker coincided with the field of chemistry lagging behind the First Industrial Revolution."[47]) Petrochemical materials, such as celluloid and plastic, replaced bone and horn in the production of jewelry, boxes, and games. Bakelite, invented in 1909 by Leo Baekeland, was the first plastic resin to substitute for ivory, used to make billiard balls, as well as toys, radios, automobile parts, pens, lamps, ashtrays, and coffee grinders. In 1913, the Haber-Bosch process made it possible to invent chemical fertilizers by fixing atmospheric nitrogen. For economic and hygienic reasons, these chemical fertilizers soon became preferred over sludges and excrements due to their higher quality and lower toxicity.

"The guano from Peru, the nitrates from Chile, and even more so, chemical fertilizers worked against the use of human fertilizer," confirms Alain Corbin in *The Foul and the Fragrant*. The development of chemistry accompanied an increasing sensitivity to odors, to which ragpickers initially provided a response. The emerging bourgeoisie, which preferred modesty over the exuberance of the aristocracy, advocated for milder scents. The advent of individualism and a strong state contributed to the privatization of waste. All of these phenomena led to a greater emphasis on hygiene, overshadowing utilitarian considerations, despite their significance. "More than ever, 'disinfecting'—and thus deodorizing—was part of a utopian project: one that aimed to seal the testimonies of organic time, to repress all irrefutable markers of duration, these prophecies of death that were excrement, menstrual products, carrion decay, and the stench of the corpse. Olfactory silence not only disarms the miasma, but it denies the flow of life and the succession of beings; it helps bear the anxiety of death."[48]

Later on, hygiene often served as a pretext or justification for the development, made possible by industry, of disposable products, as philosopher Jeanne Guien eloquently recounts in her book *Consumerism Through Its Objects: Display Cases, Disposable Cups, Deodorants, Smartphones...*[49] The author cites the prohibition of tin cups, available at public fountains in the early twentieth century in the United States. Out of concern for germs, public policy-makers launched prevention campaigns and replaced the tin cups with single-use cups made from paper coated with paraffin, then cardboard and plastic, which saw the global success that we know today. Another famous example is the creation of disposable tissues, the famous Kleenex©, by the company Kimberly-Clark in 1924. Initially, they were invented to dispose of surplus cellulose fibers used for bandages during World War I and were initially intended for removing excess makeup cream before gradually transforming into tissues. While doctors had already recommended the use of disposable fabrics for hygiene reasons in the nineteenth century, it was only afterwards that the company used this argument to sell its product. With the massive democratization of consumption, "waste began to be equated with abandonment," as explained by sociologist Baptiste Monsaingeon in an interview for the podcast *Metabolism of Cities*.[50]

To accompany this evolution, public hygiene policies were also implemented, with the most notable symbol being the generalization of the trash can, made mandatory in Paris through a decree on November 24, 1883. Symbolically, it is important to note that Prefect Eugène Poubelle had initially hoped for sorting by residents, encouraging them to

The advent of individualism and a strong state contributed to the privatization of waste.

47 — COMPAGNON Antoine. *Les Chiffonniers de Paris*, Paris : Gallimard, 2017.

48 — CORBIN, Alain. *The Foul and the Fragrant: Odor and the French Social Imagination*. Leamington Spa: Berg, 1986.

49 — GUIEN Jeanne. *Le Consumérisme à travers ses objets : Vitrines, gobelets, déodorants, smartphones…* Paris : Éditions Divergences, 2021.

50 — Podcast with Baptiste Monsaingeon. "Déchets : Ressources ou Pollution ?". *Metabolism of Cities*. February 8, 2023.

throw sharp waste such as glass and oyster shells into one box and household waste into another. These garbage boxes were calibrated and designed to be easily emptied into collection carts at regular intervals, while caretakers had the heavy responsibility of taking them out and keeping them clean. One might imagine that the population at the time, tired of living surrounded by garbage, would be relieved or even unanimously support this reform. However, the opposite was true. The decision was met with fierce criticism from opponents and constant mockery in the satirical press. In an engaging article titled "Eugène Poubelle Put into a Box!" historian and curator Agnès Sandras reveals the surprising content of these controversies. Firstly, Poubelle, the Prefect of the Seine, was accused of negotiating with garbage bin manufacturers behind the scenes, thus appropriating citizens' waste without compensation. Another criticism, which may seem surprising, was the measure's egalitarian nature: due to the trash cans, both wealthy bourgeoisie and domestic workers would find their food scraps in the building's courtyard!

The birth of the trash can marks the end of the ragpickers' reign.

In the *Journal amusant*, a short story portrays a bourgeois couple and their maid sorting through waste:

"The Maid: Should the bone from the leg of lamb go with the oyster shells?

Mr. Bellavoine: Obviously, it is unsuitable for agriculture.

Mrs. Bellavoine: Personally, I would put it with the household waste; it can be used for animal charcoal.

Mr. Bellavoine: To refine sugar. It doesn't promote growth in the fields.

The Maid: Drat! I'll just stick it in the middle... and what about Madame's old pouf?

Mrs. Bellavoine: On the rags... They are foolish with their waste classification: there should be as many containers as there are categories of objects."

Furthermore, the press was concerned about the fate of the ragpickers: what would become of them now that they could no longer rummage through the garbage, all piled up and locked in a box? In the trash can, all the waste got mixed up, and its quality deteriorated. Faced with the protests of the ragpickers and their allies, Eugène Poubelle relaxed the regulations and allowed them to sort the waste on a white sheet before the cart passed by. Nevertheless, the birth of the trash can marks the end of the ragpickers' reign: "They were gradually driven out of the fortifications of Paris, toward the outskirts," recounts academician Antoine Compagnon, "because they were less needed. They then began using not a basket but a cart and collected almost anything. Scrap metal dealers took over, as scrap metal is still profitable for recycling today." According to Sabine Barles, it is in the 1930s that society definitively abandoned this waste valorization: incineration was too costly, spreading fields required too much space and water, and ragpicking raised too many hygiene concerns. The development of small collection enterprises and the transition to automobiles and compacting bins that compressed waste eventually made any ragpicking activity virtually impossible, making way for increasingly professionalized waste collection, albeit still a profession that was socially stigmatized.

The First Collection and Cleaning Companies: Transportation in the Service of Cleanliness

Initially, street cleaning and sludge removal were entrusted to multiple small family-owned companies. Unlike water services, waste management did not initially require significant capital or technical, commercial, or contractual

Eugène Poubelle

THE PREFECT[1] WHO AIMED TO CLEAN UP PARIS

As the inventor of the trash can and a pioneer of selective sorting, Eugène Poubelle, prefect of Seine, revolutionized hygiene in Paris and in France. But how did the surname "Poubelle" become the accepted French word for a garbage bin?

Eugène Poubelle was born in Caen, 1831, into a bourgeois family. After studying law and obtaining a doctorate, Poubelle began his career as an academic. It wasn't until the age of forty that this distinguished professor took on administrative duties when Adolphe Thiers, the president of the Third Republic, appointed him as prefect of Charente in 1871. From 1871 to 1883, Eugène Poubelle served in various prefectures in France, including Isère, Corsica, and even Bouches-du-Rhône.

In 1883, Eugène Poubelle settled in Paris and became the prefect of Seine, a position that was more or less equivalent to that of the mayor of the capital—a role previously occupied by Baron Haussmann about thirty years earlier.

Convinced by hygienist ideas, Poubelle, who took office in October, issued an order in November (the 24th, to be precise) that organized waste collection in Paris. This measure revolutionized the daily lives of Parisians.

The order required property owners to provide their tenants with "wooden containers lined with tin" and equipped with a lid, for collecting waste. These containers were then placed in the street by each building's concierge, for collection. But that's not all—Prefect Poubelle also envisioned the beginnings of selective sorting: an additional box was provided for papers and rags, while a third box was designated for broken crockery, glass, and oyster shells.

Both Parisians and the media reacted strongly against these changes. The *Petit Parisien* newspaper's headline on January 10, 1884, read, "You'll see that one of these days, the prefect of Seine will force us to bring our garbage to his office."

On January 15, 1884, the measure was implemented, and Prefect Poubelle was accused of trying to eliminate ragpickers, who would see a decline in their activities. On January 16, an article in *Le Figaro* mentioned for the first time the "Poubelle boxes," which would later become commonly known as *poubelles* (trash cans) in everyday language. In fact, the word "poubelle" appeared in the *Grand Dictionnaire universel du XIX^e siècle* (The Great Universal Dictionary of the 19th Century) as early as 1890. It was listed a few pages after the term Haussmannien (referring to Baron Haussmann's urban renovation), and unfortunately, it acquired a less praiseworthy connotation.

In his hygienist efforts, Eugène Poubelle went beyond waste collection—he was also responsible for the first ordinances imposing sewer systems ●

1 — In the context of France, a prefect is a high-ranking government official who represents the central government at the departmental level.

Unlike water services, waste management did not initially require significant capital or technical, commercial, or contractual expertise of the sort which led to the emergence of a Compagnie Générale des Eaux (CGE).

expertise of the sort which led to the emergence of a Compagnie Générale des Eaux (CGE). These companies partially earned their income by selling valuable waste. However, as the cost of cleaning increased due to urban growth and the value of sludge and rags decreased, these companies had to regularly renegotiate their contracts with the cities. Some obtained long-lasting concessions, constantly renewed, and grew accordingly, such as the Grandjouan company in Nantes, which cleaned the city's streets and transported waste from 1867 to 1947. Founded by François Grandjouan and his family, the company had fifty carts, eighty horses, sixty drivers, and one hundred sweepers to carry out its tasks. In Nantes, as well as in Paris and Lyon, the authorities wanted to encourage residents to participate in keeping the city clean by introducing a "cleaning bucket" designed to collect garbage, which became known as the *sarradine*, named after Émile Sarradin, a perfumer who proposed the creation of a municipal sweeping tax. This was in 1878, and the Grandjouan company faced an enormous workload: removing mud, garbage, excrement, dust, ashes, broken glass, weeds, tree leaves, and scattered stones from the streets, as well as sweeping squares, quays, stairs, promenades, and doing daily cleaning of market halls. They even captured stray dogs. *Tombeliers* (cart drivers), ragpickers, and sweepers worked in terrible hygiene conditions, using shovels, rakes, and picks to collect and deposit waste into the carts. The buckets had to be carried up on ladders and then emptied, a particularly exhausting task.

The need to improve these conditions led these small, local waste collection and storage businesses to turn to the mechanization of transportation and the improvement of bins and carts. To achieve this, they sometimes joined forces with other companies that ventured into automobile manufacturing. However, the transition from horse-drawn carts to automobiles was very slow. Although the first front-wheel-drive and front-wheel-steering carts were developed by the brilliant inventor Georges Latil as early as 1897, it was not until the 1920s that horses were truly replaced by automobiles, and then it was especially for reasons of sanitation, as animal excrement was now considered a nuisance. Georges Latil eventually found an inspired buyer for his innovative front-wheel drive in a young graduate of the École Polytechnique, Charles Blum. Blum saw the automobile as the industry of the future and invested the significant sum of 1,200,000 francs in the company. In 1912, the two men founded the Compagnie Générale d'Entreprises Automobiles (CGEA). The First World War quickly confirmed the performance of Latil tractors, which contributed to the national mobilization, functioning on rough terrain with four-wheel steering and drive. After the war, CGEA provided traction vehicles to many municipalities that wanted to use them for street cleaning, particularly in certain neighborhoods of Paris. To expand the company, Charles Blum chose to acquire small transport companies in provincial areas, such as Maison Robert Vallée in Caen and Maison Jean et Beuchère in Rennes, which enabled CGEA to obtain contracts for household waste collection in these cities in 1930 and 1934. Although the Grandjouan family in Nantes resisted abandoning their horses for a long time, they eventually succumbed to the gradual relocation of landfills and fertilizer delivery points, since horse-drawn carts could not travel more than eight kilometers. In contrast, tractors could venture up to twenty-five kilometers. Convinced, the Grandjouans added a transportation service to their street-cleaning business.

The figure of the ragpicker, often a local presence, gradually gave way to that of the road worker or garbage collector, clinging to the back of their garbage truck. They began working very early in the morning and carried the waste farther away, as people no longer wanted to live near garbage dumps. The issue with waste was no longer finding a new use for it, but burying or disposing of it in rivers via sewage systems. Those who managed the waste worked difficult jobs that were often the objects of disdain, but they allowed city dwellers to live in clean cities.

[Continued on page 138]

From Ragpicker to Social Observer: The Figure of The Garbage Collector in History

"Garbage collector,' that's the 1970s, it's over. Now, in 2021, it's a 'refuse collector,' you know!" In the words of Jimmy, a young TikToker who works as a cleaner in his city and built a reputation on social media during the Covid pandemic, the semantic shift reflects the need for recognition in a profession that has not changed much in seventy years. Certainly, the days when road workers, ragpickers, and carters worked in appalling conditions between the late nineteenth century and the 1930s are long gone. From morning till night, they toiled with great difficulty to clean impassable and hard-to-reach streets, to carry heavy metal bins up makeshift ladders and dump them into the truck, and sometimes to sift through them for initial sorting. However, the hardship of the work remains a historical constant for a profession confronted with the risks associated with proximity to waste and road traffic.

The French word for "garbage collector", *éboueur*, comes from the word *boues*, which, as early as the Middle Ages, referred to the mixture of household waste, soil, sand, animal excrement, and other residues that accumulated on the streets of large cities, particularly in the central gutter designed to remove them with the rain. At that time, the *boueux* or *boueurs*—of which éboueur is a euphemism—or the *gadouilleurs* represented the last link in the garbage recovery chain. Although the transformation of this mud into manure gave it increasing value, this work was an object of disdain throughout the nineteenth century, and it was the least fortunate ragpickers or farm servants who took care of it. With the invention of the garbage can and the proliferation of waste in the twentieth century, the profession evolved: in large cities, private companies, such as CGEA and SITA in Paris or Grandjouan in Nantes, sometimes joined municipal authorities to systematically collect garbage. The figures of the sanitation workers began to resemble what we know today: a truck driver, two loaders at the back, called "garbage collectors" or "refuse collectors," and one or two street sweepers, often women at that time. In the 1920s–1930s, the ragpicker on the cart, who participated in the rounds for the purpose of sorting, was replaced by a municipal road worker.

In 1936, during the Popular Front, garbage collectors went on strike en masse and obtained their first social benefits. Employees working for private companies eventually, after a long struggle, obtained the same rights as municipal employees. Mechanization also improved their working conditions, and compacting bins saved them time, but the profession in cities would not change much for decades. In rural areas, collection was more artisanal and rustic, both in terms of equipment and organization. Garbage was collected by ragpickers, scrap dealers, all kinds of recyclers, and local farmers using a cart and horses, or occasionally a tractor. It would take until at least the 1970s to see the modern system being implemented everywhere, following the model of major cities like Paris, Lyon, or Nantes.

During the *Trente Glorieuses* (the thirty years of economic prosperity following World War II), the profession began to gain better recognition, although this recognition remained very ambivalent. On the one hand, garbage collectors were appreciated for cleaning cities where waste

© Eugène Atget

proliferated, but on the other hand, few wanted to see their children pursue this career. “If you don’t work hard at school, you’ll end up at Grandjouan!” was the threat in Nantes and its region, recalls Franck Pilard, RVD Sales Director at Veolia. Nevertheless, the garbage collector was part of the life of a neighborhood or village and even evoked nostalgic childhood memories for some. In 1969, the famous cartoonist Marcel Gotlib portrayed “the garbage collector of [his] childhood” in a comic strip from the *Rubrique-à-brac* series, using laudatory terms without a hint of derision: “Yes, it was him, clinging to the side of his machine, like Apollo on his chariot, radiating in the rising sun.” Young Gotlib watched the garbage collector go about his rounds and leave, “taking with him a scent of mystery and adventure,” until one day he succeeded in meeting him and being initiated into the joys of garbage collection. Antoine Compagnon, author of the book *Les chiffonniers de Paris*, regrets that they are seen less often: “When I was a child in Paris, we saw them during the day; they collected garbage between 7 a.m. and 8 a.m. Their current discretion is also linked to the transformation of large cities, because neighborhoods at the time had retained a sense of community that has now been lost, along with small businesses.”

In rural areas and small towns, this proximity has not been lost. Researcher and teacher Marc Conesa lives in a village in the Pyrénées-Orientales where garbage collectors still play the role of social observers: “They create a presence at specific times. In the morning, we see them at the bakery before or after the collection, checking that everything is fine, that the grandmother has taken out her trash, that the dog is not on the road, etc. They are agents who have a good knowledge of the area; they know the schedules of residents and shopkeepers, and they are the ones who find lost, sick, or intoxicated people in the street.” Our new relationship with waste, partly through sorting, recycling, and valorization, but also growing out of times of crisis, reveals their importance in the eyes of the population. During the Covid pandemic, for example, garbage collectors were applauded and received letters of congratulations, but the strikes in 2023 were supported to varying degrees by the French, with 57 percent of them wishing for the requisitioning of employees.

Today, the garbage or refuse collector is essential for maintaining clean cities. If society wants to meet the challenge of waste reduction, this profession will need to evolve in the future. According to Franck Pilard from Veolia, “we need to reduce the frequency of household waste collection and decrease the size of bins to encourage citizens toward more responsible consumption. This implies involving more people in the subject of reuse, repair, and supporting our employees even more to become ambassadors of recycling.”

Today, both companies, Grandjouan and CGEA, are part of Veolia's history. "For decades, local authorities 'made do' with solutions for waste collection and disposal," explains Franck Pilard, Veolia's Commercial Director for Local Authorities in Waste Recycling and Valorization. "Some municipalities had waste evacuated by a small local agent—the mayor's brother or a family farmer—sometimes until the 1960s. They were family businesses with a long history that were acquired by CGEA when they needed to scale up due to demographic, urbanization, and household consumption pressures."

Thus, Veolia's waste collection and valorization activity has two origins. One is through organic, biological development, "which grows gradually," to use the words of Paul-Louis Girardot, former CEO and administrator of the group. As early as the 1960s, CGE developed waste collection activities, such as in Saint-Omer, where the municipality realized that "it was not working well" and that those responsible for waste collection were "not very reliable" and needed help. The other origin is through acquisitions. In 1980, CGEA was fully integrated into the Compagnie Générale des Eaux, which was already a shareholder of the company, to consolidate a coherent range of service offerings: water, sanitation, waste, and cleaning. In addressing both municipalities and industrial clients, Veolia acquired companies such as Ipodec, "whose original name, 'Ordures usines' or 'Factory Refuse,' left no doubt about its core business!" recalls Didier Courboillet, Deputy CEO of Veolia's Waste Recycling and Valorization activity. This activity was briefly known as Onyx until the creation of the Veolia brand.

"We are the originators of recyclers, scrap dealers, and cardboard collectors," confirms Martial Gabillard, Director of Resource Recovery at Veolia, proud of this heritage and the practical and meticulous mindset that has persisted over time. Today, echoing the ragpickers of yesteryears, this former regional director in Rennes mentions the paper mills: "We do everything for them, we manage their sludge and supply them with paper for recycling. We take care of their supply, provide them with energy through sludge, and treat their water. In short, we support them throughout the significant challenges of their profession." Between the past and present, the cleanliness professions today rediscover the concept of waste as a flow, value, and circularity, with the difference that they must manage unprecedented quantities and types of waste.

"Collection wasn't so complicated," says Franck Pilard, "it was mainly about hygiene-related disposal, so municipalities could handle it. However, waste treatment has always required more in-depth skills and investments, which is why municipalities tstill delegate more to private companies today. Our strength lies in this public service delegation model, which allows Veolia to leave a mark through this approach that has spread worldwide." In the 20th century, the age of recovery gradually gave way to the era of waste treatment. Now, the focus is on transporting them far away for incineration or industrial burial. "Conceal this waste that I cannot bear to see," could be the adage of the time. The concern for urban hygiene takes precedence over everything else, long before ecological considerations question this model

"We are the originators of recyclers, scrap dealers, and cardboard collectors."

Martial Gabillard

UNITED KINGDOM

In London, Cleanliness is a Top Priority for the Iconic Westminster District

Big Ben, the Palace of Westminster (seat of the British government), Buckingham Palace (seat of the British monarchy), Tate Britain, St. James's Park, Victoria Station... all these iconic places are located in one prestigious district in the heart of London: Westminster. And this political and tourist center of the United Kingdom is given special attention.

To meet the expectations of the millions of people who pass through this iconic district every day, Veolia has been ensuring its cleanliness twenty-four hours a day, seven days a week since 1995. Every week, 200,000 tons of waste are processed and 8,400 kilometers of streets are swept. Busy arteries, such as Oxford Street and the surroundings of Piccadilly Circus, are swept two or three times a day and at night to ensure compliance with the strictest cleanliness standards.

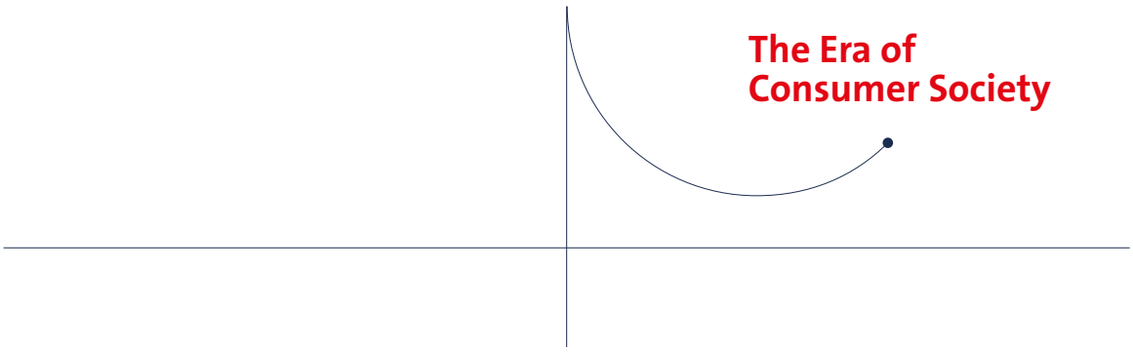
This London district is the venue for numerous annual events such as the London Marathon, the Notting Hill Carnival, the annual Pride march, and of course, major royal events such as jubilee celebrations, weddings, coronations, and funerals. Therefore, in addition to the daily maintenance required in Westminster, Veolia's teams are on hand to provide top-quality cleaning services during these large gatherings.

One can see electric waste collection vehicles busy about the streets of Westminster, which are recharged with green electricity produced in the waste treatment plant serving the district's residents: a closed loop! To further enhance the cleaning service, Veolia is partnering with Westminster to make it a "zero-emission" local authority by 2030, through an electrified fleet and innovative collection methods.

These services are always encouraged to improve, with a performance-based market that remunerates the operator based on the achievement of goals set in the contract. This serves as a driving force to ensure a level of cleanliness in the city that is...well, fit for a king, to such a degree that the streets used for the coronation of Charles III were returned to the public on Sunday evening that same weekend ●

Story
8

Treating Waste



In the past, when waste was considered a resource, it did not need to be treated. It was either collected for free by ragpickers or, in the case of organic materials, sold to be spread in fields that supplied the urban market. The break in this cycle was due to the significant increase in volume of waste caused by urban expansion and, consequently, the deadly epidemics caused by water contamination. It was also due to the emergence of new chemical and industrial pollutants that could not be assimilated by the soil's metabolic cycle.

However, waste treatment only gradually appeared, with the initial phase consisting of removing waste and making it invisible through burial or incineration, without considering the environmental consequences. In 1886, New York dumped 80 percent of its waste into the Atlantic Ocean, a good portion of which washed back along the coast and its beaches. The arrival of automobiles was seen as a solution to the nuisances caused by horses, while the first citizen mobilizations on the subject were led by women, for aesthetic and domestic reasons. The first generations of incinerators in the United States, in the 1920s, resulted in terrible pollution, contributing to environmental inequalities. It was through their territories' limited capacity to absorb these pollutants that cities gradually reached their limits, forcing them to gradually treat their waste and once again delegating this invisible part of the city to other agents. If waste had been managed on a national or global scale, there is no doubt that waste's relegation to neglected and stigmatized areas without concern for treatment would have continued, as evidenced by today's illegal trafficking of hazardous materials such as electronic waste or certain chemicals •

GRÉGORY QUENET

In the nineteenth century, if the concept of "circular economy" did not exist, it is simply because it had always been in practice, implicitly, without needing to be defined. The few products that society considered useless and disposable often ended up in the soil or water, but they were assimilable, as they were few in number and mostly organic. A profound rupture occurred during the twentieth century, driven in particular by the chemical and petrochemical industries that fueled consumer society. As society urbanized, waste became "bulky," to use a term still used today for some of them. Influenced by hygiene, there was a need to treat waste first as a flow, meaning transporting it out of cities by horse-drawn carriages and later trucks, as well as utilizing the kinetic force of water through sewage systems. In his book, *Le Propre et le sale*, Georges Vigarello draws a parallel between these two depreciated professions: the "dawn workers" who collected garbage and the "water workers" who operated in the sewers. It was a shadowy job that made this waste invisible. Waste was then stored in landfills increasingly farther away as rapid urbanization brought people closer to their own piles of garbage. No one wanted to live near these cesspools, amid the foul odors. The twentieth century marked the culmination of the long process of the "olfactory silence" of cities, as beautifully named by Alain Corbin in his seminal work on smell and social imagination, *Le Miasme et la jonquille*.

From this visceral need for cleanliness, a profession was born: waste collection and transportation, which revived the same debate as water services in the late nineteenth century, regarding the choice between municipal management and public service delegation. Unlike water distribution services, which saw the creation of two private giants, the Compagnie Générale des Eaux (CGE, now Veolia) and the Lyonnaise des Eaux (now Suez), waste management and garbage collection services were in the main run by small local and artisanal companies initially, as they required fewer resources. Even during the First World War, these small companies' organization was not questioned, despite facing a series of difficulties (staff shortages, horse requisitions, a downturn in sludge sales, expensive goods, etc.), and the city of Nantes, for example, continued its contract with the Grandjouan company, which later became a subsidiary of CGE. "Individual initiative is always better equipped to find remedies than a public administration," claimed the municipal council in 1915. The gradual mechanization of these jobs in the 1920s, with the first garbage trucks, and later, after the Second World War, with the widespread use of compacting garbage bins, complicated the lives of all kinds of waste collectors.

However, it was the explosion of consumption that made the old waste recovery system impossible. As early as the interwar period, certain American companies theorized the concept of "planned obsolescence" to stimulate growth. Faced with declining sales, lightbulb manufacturers agreed to limit the lifespan of their products to encourage consumers to replace them more frequently. Another famous example is DuPont de Nemours, which deliberately reduced the lifespan of stockings and tights sold by the company. The increase in waste was such that historians John R. McNeill and Peter Engelke refer to it as the "great acceleration" in their book of the same name, starting from the mid-twentieth century. These challenges required larger-scale solutions to waste collection and treatment, leading to the concentration of local companies within larger groups. This is the story of the CGEA (Compagnie Générale des Entreprises Automobiles), which integrated a series of local subsidiaries, such as Grandjouan for collection and transportation, USP (Union des Services Publics) for incineration plants, SEMAT (Société d'Équipement Manutention et Transports) for providing waste bins and vehicles, and Soulier,

acquired from Cartonneries La Rochette, for cardboard and paper recovery.

For local authorities, these companies managed one of the least noble activities: dealing with the heaps of waste produced by society. This is a little-told story, as it is about the invisibility of our waste via its burial or incineration, a necessary condition for the immaculate cleanliness of our cities and villages. But economic and ecological logic has now come to question this new order of thing

The Explosion of Waste during the *Trente Glorieuses*

Starting in 1948, the French entered what economist Jean Fourastié called the *Trente Glorieuses* (the Glorious Thirty), which lasted until 1973. While, like in many countries, there was a shortage of everything after the war, the standard of living rapidly increased during these three decades. With falling product prices, the beginning of globalization, and a new form of unabashed consumption, the accumulation of goods skyrocketed. “The world of things seemed limitless: gas stoves, refrigerators, and washing machines; indoor toilets with flushes and bathrooms with water heaters; elevators and garbage chutes; Solex bicycles and cars; transistor radios and televisions; pocketbooks and ballpoint pens; Formica kitchens and plastic basins; ‘instant’ soups and frozen foods; Omo laundry detergent and Dop shampoo; jeans and miniskirts…” lists historian Jean-Claude Daumas in his article “Les Trente Glorieuses ou le bonheur par la consommation [The Glorious Thirty or Happiness through Consumption],” published in the *Revue Projet* in 2018. This is an inventory, à la Prévert, that echoes “La Complainte du progrès [The Complaint of Progress],” a song recorded by Boris Vian in 1955.

This advent of consumer society was accompanied by numerous excesses, which gradually became subjects of conversation and attracted criticism from philosophers, ecologists, and economists. Overconsumption, waste, and pollution were vehemently denounced by Hannah Arendt,[…] [Continued on page 146]

In the Time When Garbage Trucks Were Electric

Is the electric car the future of the automobile? Difficult to say, but it is certainly its past. Contrary to what many imagine, the first electric vehicle dates back to 1834. It was designed by American Thomas Davenport and, at the time, resembled a locomotive. In 1859, Gaston Planté developed the first rechargeable battery, an invention that allowed Thomas Parker to build what is sometimes considered the first electric car in 1884, even though it resembled a horseless carriage.

Quickly, electric cars proved to be very competitive: they were reliable, easy to start, left no smoke in their wake, and cost less to build than gasoline cars. In 1898, the Automobile Club de France organized a "competition for automobile carriages" that highlighted the superiority of electric vehicles.

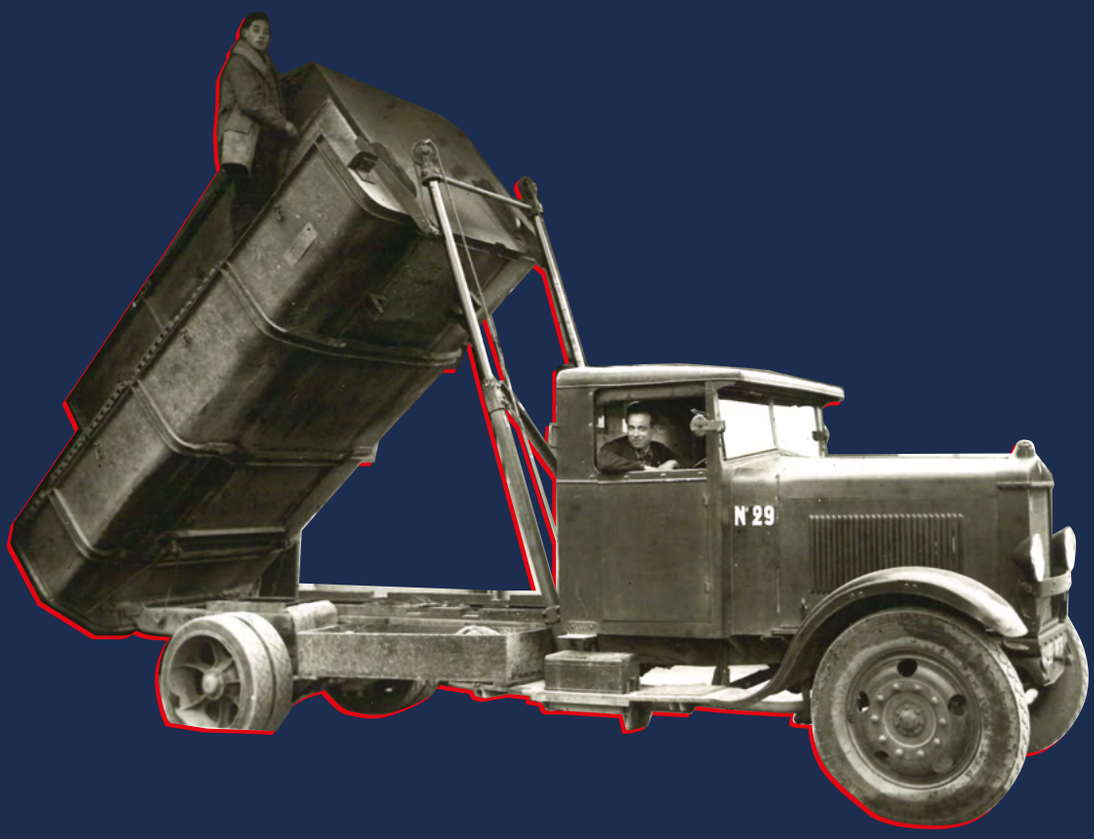
After the initial tests, eleven electric carriages and only one gasoline-powered one qualified to participate. At the end of the competition, the jury pronounced an implacable sentence: "It now seems established through experience that the petrol-driven motor carriage cannot constitute a system for operating public cars in a large city."

It should be noted that the initial use of automobiles primarily involved municipal services in major cities: mail, taxis, buses, trams, and...garbage collection! In 1900, electric taxis roamed the streets of New York and, in 1904, the city of Paris also equipped itself for interurban mail distribution. In Great Britain, milk bottles were transported from house to house in electric trucks at the beginning of the twentieth century. After World War I, oil temporarily became expensive, and the cost-effectiveness calculations quickly made sense for municipalities.

In the 1920s and 1930s, garbage trucks began to become widespread in big cities, gradually replacing the old horse-drawn carts. Founded in 1925 and based in Villeurbanne, Sovel (the Société de Véhicules Électriques) quickly established itself in the manufacture of trucks dedicated to waste collection and road maintenance. Antoine Joulot, an engineer from the mines and an administrator for CAMIA (Compagnie Auxiliaire des Municipalités pour l'Industrie et l'Assainissement), quickly realized the potential of these electric machines. He envisioned them being powered by electricity from the incinerators that his company operated in France, in parallel with the steam used in heat networks.

After Villeurbanne, Antoine Joulot conducted an experiment in Tours, where CAMIA—which would later be acquired by CGEA, a future subsidiary of Veolia—managed an incineration plant: at a speed of twenty kilometers per hour, a Sovel truck could collect garbage for forty to fifty kilometers before going to recharge at the plant.

The system was then replicated as part of a mixed management contract in Bourges in 1930: the company



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La Berruya (which included CAMIA) for the operation of the incinerator, Sovel for the collection of household waste using electric vehicles. The batteries were charged at night when the electric vehicles were idle. The electric motor, signed by Jacques Frères companies, was originally located at the rear of the vehicle (hence the very flat and vertical shape of the front cabin hood).

In Bourges, collection was carried out by five electric trucks with tilting bins closed by sliding covers. The two six-horsepower electric motors and the Tudor lead-acid battery with 380 ampere-hours had to pull five tons of payload! These electric trucks perfectly met the needs of garbage collectors: reduced speed, sufficient autonomy for a neighborhood, ability to maneuver through narrow streets, no noise nuisance, no inhalable pollution, and low energy cost.

And that's not all: mastering the driving of such a vehicle did not require any specific training. As historian Alain Belmont writes in an article, "In a Sovel truck, there was no clutch, no gearbox, no carburetor, and of course, no internal combustion engine, so there were almost no possible breakdowns. Considered indestructible, these trucks sometimes kept running for nearly fifty years!" The batteries, located in the middle of the vehicle to evenly distribute the weight, were easy to recharge from the power grid and were covered by a maintenance contract that offered several years of warranty. By the 1920s, gasoline cars were becoming much more competitive, and their prices dropped drastically, especially for the Ford Model T, which cost three hundred dollars by the end of the decade—an affordable amount for a worker. But the shortages and restrictions of World War II gave a second life to Sovel's garbage trucks. The cleaning and transportation company Grandjouan (a future subsidiary of Veolia) put two electric compacting bins into service in 1942 in Nantes. Sovel trucks were still used until the 1960s–1970s, for example in sanitation in Lyon or for garbage collection in Rouen and Courbevoie. Despite these sporadic uses, gasoline and diesel cars gained the upper hand over electricity, which could not compete in terms of cost, autonomy, and recharge speed, and Sovel definitively closed its doors in 1977 ●

Jean Baudrillard, Kenneth Galbraith, René Dumont, and others. This new form of society encouraged single-use consumer goods and the planned obsolescence of products. Instead of repairing and maintaining like their predecessors, the French began to throw things away. Disposable products multiplied, such as beer or soda cans. In 1947, 100 percent of sodas and 58 percent of beers in the United States were sold in reusable bottles; by 1971, this had dropped to only 25 percent.

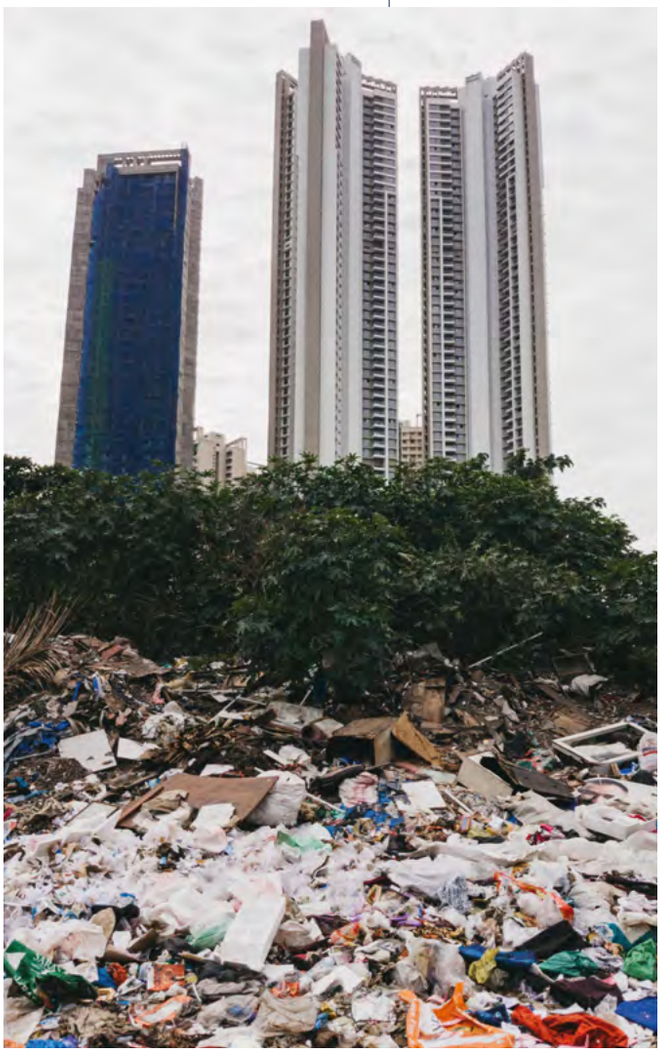
The challenges not only involved quantitative aspects but also qualitative ones, as waste became more complex than before, making it more difficult to recover for other uses, and sometimes taking decades, or even longer, to degrade in the environment. Waste also became industrial, medical, electronic, and nuclear. Plastic waste sits at the intersection of these two challenges, and it accumulates.

In 1960, each French person produced an average of 250 kilograms of waste per year. This number would only increase over the following decades, as growth of waste was estimated at 5 percent annually. To get rid of this accumulation of new waste, the solution was simple: it was disposed of without much care for the natural environment, through landfills, sewers, or even immersion. The issue of waste treatment became crucial, as the society of abundance rapidly polluted our waterways, soil, and air. This development was highlighted as early as 1962 by American economist and sociologist Vance Packard in *The Waste Makers*, as well as by Rachel Carson, the first environmentalist to raise the alarm about pesticides in her book *Silent Spring* that same year.

The question of waste treatment slowly made its way into institutions, which began to take initial measures on the subject; authorities finally recognized the nuisance caused by waste and started to regulate it. In 1972, the London Convention regulated waste disposal at sea, including hazardous waste such as industrial sludge or radioactive materials. It was one of the first international conventions for the protection of the marine environment against human activities.

In France, Laurence Rocher, a lecturer in planning and urbanism, points out that "the organization of waste collection and treatment was characterized by the absence of a dedicated national policy. The regulatory framework was produced by different ministries according to the sectors producing waste." The Ministry of Equipment was responsible for waste from public works and urban planning, the Ministry of Agriculture for agricultural waste, the Ministry of Industry for waste from manufacturing activities, and so on.

The creation of a Ministry of the Environment in 1971, whose initial objective was to combat noise pollution, allowed for the structuring of the waste



Waste in the City, India.

Until the 1970s, the state's priority was hygiene and public health, and environmental protection was only an additional consideration.

sector. Thus, on July 15, 1975, the first major law on waste management was enacted, contemporaneous with similar laws in Germany and the United States, and served as the basis for national environmental regulations. It stipulated that local authorities now had the responsibility for the collection and disposal of household waste from their constituents in approved locations. The waste producer also became responsible for their waste. This was a turning point. "When the law took effect, industrial companies asked us to dispose of their waste while demanding guarantees that the waste would be treated in accordance with regulations," recalls Alexander Mallinson, regional director at Veolia, who was responsible for waste recycling and recovery activities. It was thanks to these regulatory measures that local authorities increasingly turned to private service providers like CGEA (Veolia's future subsidiary) through public service delegations. As environmental protection rules multiplied, waste treatment facilities became more technical, and the use of CGEA became the norm.

From the Professionalization of Landfills to Industrial Ecology Hubs

Until the 1970s, the state's priority was hygiene and public health, and environmental protection was only an additional consideration. But things gradually changed, as Laurence Rocher analyzes in her dissertation *Governing Waste*: "These concerns regarding hygiene, environmental protection, and the reduction of nuisances led to the rejection of uncontrolled landfills as a disposal method and the acceptance of controlled landfills." In 1972, although 80 percent of the French population had access to waste collection and treatment services, disparities between large cities and rural areas remained significant. Thus, a large part of the territory had no access to any collection or treatment system. As a result, waste continued to feed illegal landfills. In 1978, the National Agency for Waste Recovery and Disposal (ANRED), the predecessor of ADEME (the Agency for Ecological Transition), launched the France Propre ("Clean France") program. Thanks to this program, it is estimated that 1,500 illegal landfills were eliminated or rehabilitated. But the 1980s were also marked by several environmental scandals, particularly concerning fraudulent waste management, which accelerated the transformation of the sector. One of the most emblematic scandals was the Montchanin landfill in Saône-et-Loire, where hundreds of thousands of tons of industrial and hazardous waste were dumped by trucks from all over Europe for ten years.

It all started in 1976 when the mayor of the municipality entrusted an eight-hectare plot of land to a waste operator, Luc Laferrère, who was supposed to establish the first controlled landfill in Burgundy. Only household waste was allowed on the site. But trucks registered in France, as well as in Belgium, Germany, and even Switzerland, dumped their waste, which was then covered with soil. This strange activity caught the attention of the local residents, who quickly complained about the nuisances caused by the landfill—especially the odors. In 1981, a few residents of Montchanin founded the Association for the Defense of the Montchanin Environment to address the issues related to the landfill.

The living conditions and health of the residents became increasingly alarming: several general medical practitioners in the municipality observed an increase in consultations for respiratory problems and irritation of the mucous membranes. In a series of articles in the *Journal de Saône-et-Loire* dedicated to the environmental scandal, Pierre Barrellon, a resident of

the municipality and whistleblower, explained the cause of the nuisances: "It was chemical industrial waste, as well as hospital waste. We will never really know what was buried here, but it was anything but harmless. The origin of the trucks and the reading of several subsequent reports suggest that scrapings from contaminated sites, hydrocarbons, paints, solvents, sulfur, toluene, benzene, and even phosphorus, which ignited upon contact with air, must have been buried in Montchanin. Long-term and diverse pollutants. Unstable products whose evolution, or even reactions when they come into contact with each other, cannot be predicted by anyone."

Thanks to the mobilization of the residents, the government suspended the landfill's activities in 1987 before definitively closing the site in 1989. It was not until 1998 that a trial began, when 80 percent of the adults in the town joined as civil parties. However, in legal terms, "it was much ado about nothing," to quote Pierre Barrellon, who was also the deputy mayor from 1995 to 2008. The operators were sentenced to three years of suspended imprisonment and a fine of 150,000 francs.

However, the political impact was quite different. The media coverage of the scandal had a strong influence on the creation of the July 1992 Royal Law on Waste Disposal. Its rapporteur in the Senate, Bernard Hugo, estimated at the time of its examination that it was "crucial to restore public confidence, which was marked by the Montchanin scandal," while also believing that "the evolution of the waste management market represents an economic development opportunity for French industrial companies in this sector, which have significant technical expertise."

The Royal Law promoted the environmental quality of landfill sites. It put an end to existing landfills by providing financial incentives for the restoration of collective municipal waste disposal facilities and the remediation of land polluted by these facilities. The law also aimed to definitively close small illegal rural landfills.

In the 1980s and 1990s, CGE and its subsidiaries acquired landfill sites to manage them in a more standardized manner. And indeed, in recent years, landfill management has become more professionalized, thanks to specialized companies like CGEA. The landfill sites, previously owned by a wide range of owners, including individual holders and civil engineering companies ("the 'REP' in Claye-Souilly initially stood for Routière de l'Est Parisien!" recalls Didier Courboillet, Deputy General Manager of Recycling and Waste Recovery in France), will see their organization become more streamlined. Control of waste at the entrance, strict distinctions between ordinary waste and hazardous waste, the impermeability of landfill cells, leachate recovery and treatment, the reduction of nuisances for nearby populations... The management of these sites has proven to be demanding, especially as new expectations for the circular economy emerged in the 1990s.

In recent years, landfill management has become more professionalized.

These sites are still necessary for the disposal of non-recyclable waste, and according to ADEME, there are still 36,000 illegal landfills in 2022. But they have gradually transformed into industrial ecology hubs, accumulating functions. They develop their energy production from buried waste, converting methane from the fermentation of organic waste into electricity or biogas. The Claye-Souilly landfill has thus become one of the largest biomethane production units in Europe and an emblematic site for renewable energy production in the Île-de-France region.

They also incorporate recycling, the composting of plant waste, transformation of bottom ash, and valorization of used tires, among other functions, while making room for other facilities. For example, Veolia inaugurated its first waste collection centers as early as 1986. As sorting centers were established, the company began to close old landfills. This was the case with the Tougas landfill, which closed its doors in 1992, and Veolia took charge of its post-operation. "This means that we ensure the end-of-life management of the landfill, installing drains, gas capture

systems, covering it, and monitoring its evolution and effluents. It is a great responsibility because we have to ensure the management of potential pollutants," explains Annaïg Pesret-Bougaran, director of the Arc-en-Ciel sorting center in Couëron, Loire-Atlantique, which was built a few kilometers from the now-closed landfill site. Its seventy hectares have been replaced by tree hedges and photovoltaic panels.

Post-operation also ensures, according to specific health and environmental rules, the progressive restoration of these spaces that were borrowed from nature. At the Claye-Souilly site in Seine-et-Marne, Veolia is responsible for replanting the largest forest in Seine-et-Marne since the nineteenth century, when the department was extensively deforested to meet the demand for wood supply and agricultural land development.

Incineration: The First Alternative to Landfill

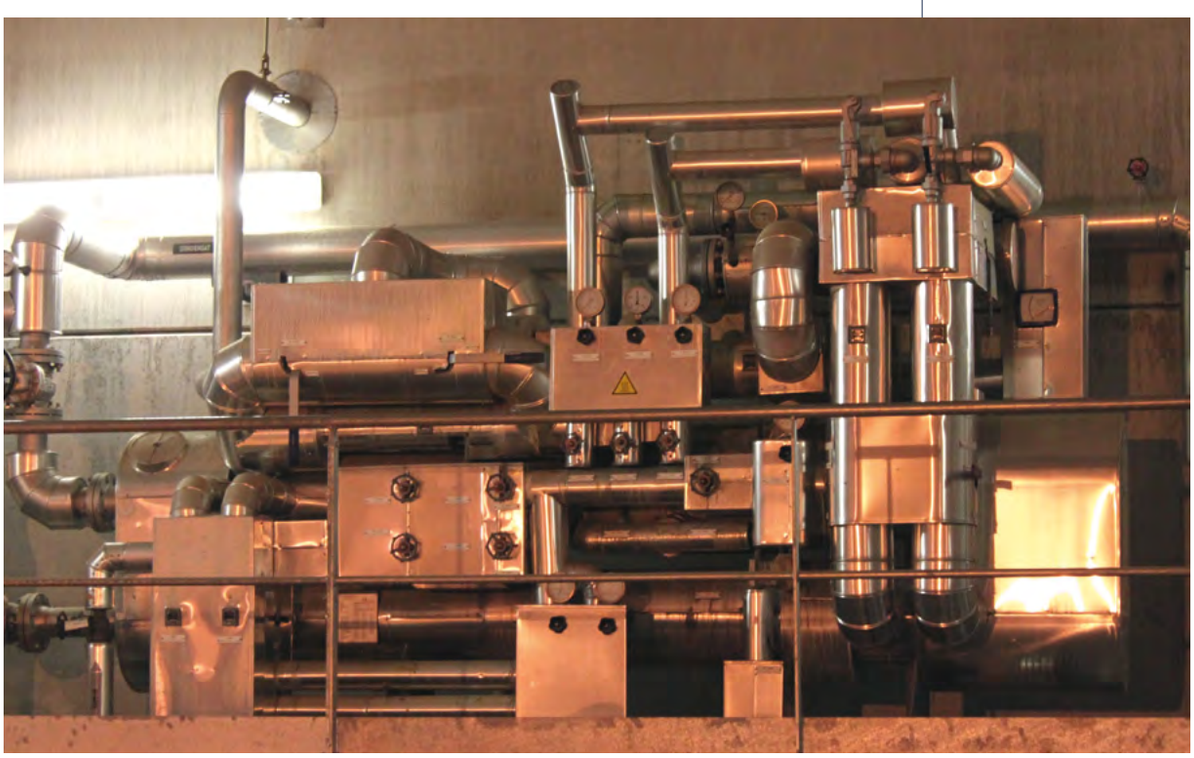
Originally, the two basic waste treatment methods were landfilling and incineration. Both processes have contributed to the cleanliness of cities since the late nineteenth century. At that time, landfills were more often located in rural areas, while incinerators were found in urban areas. This distribution was driven by the cross-cutting imperatives of public health (waste placed in landfills could attract bugs and larger animals and pollute water) and performance (incinerators being more efficient in reducing the significant volume of urban waste). Additionally, the geographical constraints played a role, as vast and sparsely populated rural areas could more easily accommodate landfill

Garbage collection by dump truck in Montmartre, 18th district of Paris, 1950s.

sites, while cities required facilities with a smaller footprint.

The English were the first to develop incineration solutions in 1865, installing a modest furnace in Gibraltar to burn waste from the British army. In 1870, the first municipal incinerator was established in Paddington, a London district. At that time, these "destructors," as they were called across the Channel, did not function well and did not burn all the waste, causing black smoke in the surrounding areas. However, newer generations of incinerators increased the efficiency of combustion and allowed for the utilization of energy for heating or electricity. According to Gérard Bertolini, a CNRS research director, "in 1906, 140 to 180 (over 150, according to other sources) English cities primarily used incineration to treat waste, and over half of them recovered the energy produced, including 45 to 65 cities linked to power plants."

In France, it was not until 1905 that the first incinerators were established in four waste treatment plants: in Saint-Ouen, Issy-les-Moulineaux, Romainville, and later in Ivry (in 1912). In 1927, SEPIA (Société d'Entreprises pour l'Industrie et l'Agriculture) built a modern incineration plant in Tours, capable of producing electricity and bricks from the recovered bottom ash after combustion. It was even decided at the time that waste collection would be carried out by electric trucks that could recharge directly at the plant. In the 1930s, under the influence of the hygiene movement, incineration gained significant popularity, as fire was believed to purify everything. The Union des Services Publics, a future subsidiary of the CGEA group and Compagnie Générale des Eaux, developed incinerators in Bordeaux (1932), Rouen (1933), Nancy (1933), Marseille (1935), Roubaix (1936), Monaco (1937), and Bourges (1938). By 1939, over twenty French cities had adopted incineration. In contrast, both England and the United States gradually shifted away from incineration and towards sanitary landfilling, as certain waste did not burn well and residents began to complain about the proximity of incinerators due to the foul odors. In France, incineration continued to coexist alongside landfills after World War II: the Nanterre plant incinerated waste



Waste Incineration Plant, 2015.

from seven municipalities in the western suburbs, and the city of Lyon supplied its incinerators with waste from neighboring municipalities.

Incineration experienced a renewed interest in the 1990s. The 1992 law provided for the limitation of landfilling as a waste disposal method. Its importance grew even further in 1994, when the law prohibited incineration if it did not allow for energy recovery. The objective was to valorize both the materials and the energy content of waste, which could produce heat or electricity. This led to the systematic deployment of old but previously outdated processes due to the emergence of other, cheaper energy sources, as well as the implementation of policies that encouraged industrial efficiency on their facilities. Although the 1992 law favored waste incineration over landfilling, the development of energy recovery systems progressed slowly. In a 1999 report on waste valorization techniques, the Senate noted that out of 139 incinerators, "almost three-quarters...do not have energy recovery." More broadly, while France was among the countries with the highest number of incinerators at that time, incinerating 40 percent of its municipal waste, it lagged behind Sweden (45 percent), Denmark (56 percent), Switzerland (60 percent), and especially Japan, where incineration was the predominant waste treatment method (75 percent).

It was not until the 2000s that incineration plants transformed more widely into energy recovery facilities.

It was not until the 2000s that incineration plants transformed more widely into energy recovery facilities, while simultaneously facing—ironically—a new health challenge: air pollution. While pollution from incineration emissions was not a concern in the 1950s due to limited knowledge of its effects and composition, the situation changed in the 1970s. Environmentalists began to closely examine these issues, to the point that in 1975 the Friends of the Earth in Privas, Ardèche, filed a lawsuit against a municipal solid waste incinerator project. "The installations were subject to dust reduction measures" during that decade, according to the journal *Pour Mémoire*, published by the Ministry of Ecology. Treatment of emissions further intensified in the 2000s, aided by the initiatives of companies like Veolia. Annaïg Pesret-Bougaran explains that the installation part of incinerators has evolved the most: "Initially, we had a reactor and lime milk injection with electrostatic precipitators that captured treatment residues and combustion dust. However, in 2001, the regulations changed, and the list of pollutants to be treated increased. In 2007, we carried out major renovations on our site in order to treat the exhaust gasses and monitor emissions." In addition, air quality measurements are conducted in the region of the plant twice a year in collaboration with the Regional Directorate for the Environment, Planning and Housing (DREAL). Today, Veolia ensures compliance with these requirements in forty-five incineration units, representing 40 percent of the operational incineration plants in France.

Furthermore, all these forty-five plants are equipped to recover energy from waste. They are often even connected to district heating networks. Waste is no longer simply treated or stored, but has become a source of value. This paradigm shift is summarized by Didier Courboillet: "In the twentieth century, we wanted to quickly get rid of waste without doing anything with it. Today, the amount of waste is still significant, but we work to extract value from it, which was already there from the start. We advocated for the creation of the law on extended producer responsibility (REP) in 1992, which gave rise to eco-organizations. Before that, when we collected waste, we filled the truck to its maximum capacity and mixed everything together. We realized that it was more productive to deconcentrate the waste flows compared to simply landfilling them and to seek value in waste." This is a first step toward recycling, the cornerstone of the circular economy, without which the ecological issue of waste cannot be solved

BRAZIL

Brazil: Pollution Becomes Solution in Landfill Sites

Not all waste is currently recyclable, and not all of it is sorted. As a result, stocks have accumulated in landfills over the decades. Among them, organic matter emits methane, a greenhouse gas that contributes to climate change when released into the atmosphere. However, if captured and transformed into biogas, this pollution can become a solution by serving as a renewable energy source of organic origin, as an alternative to fossil fuels. This change in perspective is gradually taking place in Brazil, as in many other countries.

With its 214 million inhabitants, the eighth largest economy in the world produces eighty million tons of waste each year. Half of this waste ends up in one of the three thousand illegal and uncontrolled landfills located across this largest country in the Southern Hemisphere. To address these diffuse sources of pollution, new scenarios can now be written.

In 2021, Veolia teams inaugurated three new power plants directly installed on landfills in São Paulo, Iperó, and Biguaçu. Through professional exploitation and a focus on the circular economy, "these units will produce 12,400 kilowatts of renewable electricity from biogas derived from organic waste," emphasizes Gustavo Migues, Director of the Latin America zone at Veolia. Importantly, the biogas supplied by these plants helps avoid the emission of forty-five thousand tons of methane into the atmosphere. These solutions can play a significant role in the evolution of Brazil's energy mix, combining with other waste-to-energy methods. Further south, Veolia has partnered with the agri-food company Camil Alimentos to manage, operate, and maintain a cogeneration plant, where ninety-five thousand tons of rice husks—the outer layer of rice discarded during the bleaching process—generate the electricity and steam needed by the facilities each year. With further research and development efforts, sugarcane bagasse could also be included in this circular economy framework ●

TURKEY

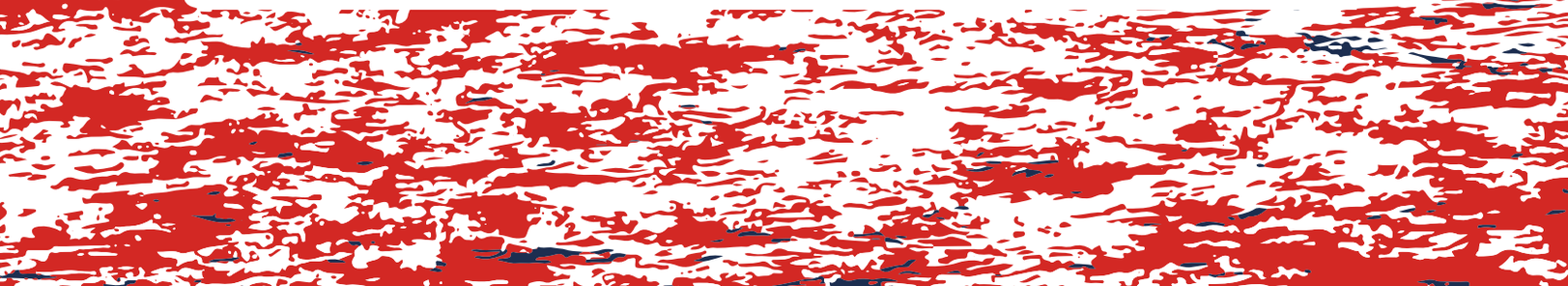
In Turkey, an Exemplary European Installation for Converting Waste into Energy

Waste management in Turkey is a significant problem. With one of the lowest recycling rates among OECD members, barely reaching 12 percent in 2018,[1] and an insufficient capacity to handle its estimated five million metric tons of waste per year, the country faces a major environmental challenge.

In this context, Veolia was entrusted in 2023 with the operation of Istanbul's waste-to-energy plant, in compliance with European Union environmental standards. Its mission is to bring this installation, the largest in Europe, to full capacity.

With a processing capacity of approximately 1.1 million tons of non-recyclable household waste per year, the plant will save nearly 1.5 million tons of carbon emissions annually, thanks in part to the production of 560,000 megawatt-hours of electricity, equivalent to the consumption of 1.4 million metropolitan residents. This is the first installation of its kind in Turkey, aiming to decarbonize the waste sector through the widespread adoption of energy recovery and recycling, in order to avoid carbon-intensive landfilling. This project directly contributes to the country's carbon neutrality goal by 2053, marking a new milestone in the journey toward decarbonization ●

1 — "Classement des États du monde par taux de recyclage (% déchets collectés)", *Atlasocio.com*, published August 24, 2020.



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Story
9

Recycling Waste

Between Fundamental Rediscoveries and a New Industrial Epic

The gap between the rapid technical invention of solutions for valorization and the slow adoption of new sorting practices prompts us to return to the historical roots of recycling. On one hand, today's circular economy has nothing to do with waste-free organic societies, as current valorization relies entirely on the production of waste, (i.e., discarded material, detached from the person who produced it, who no longer wants to see it). Therefore, it is necessary to raise awareness among users who have become insensitive to this invisible part of themselves. It would be more effective to work upstream so that no one can say of any material, "This is no longer me." International comparisons show that waste valorization can paradoxically be easier to implement in emerging countries where waste has always been a resource for the local populations living around and on landfill sites.

On the other hand, it is essential not to forget that the transposition of Antoine Lavoisier and Jean-Antoine Chaptal's organic chemistry expertise into the industrial and judicial realms resulted in the idea that waste is nothing more than a residue waiting to be chemically valorized. This neutralized all fights against pollution in the nineteenth century. The growth of the new recycling market today requires a contract of trust that clears up ambiguities and invents a new metabolism that cannot be a reactivation of an idealized past •

GRÉGORY QUENET

Modern recycling, as we understand it today, gradually emerged in the twentieth century, particularly in the second half of the century. In Great Britain, the verb "to recycle" has been in use since 1926, and the term "recycling" appears shortly after World War II. In France, the term *recyclage* first appeared in 1960—but it wasn't until the 1970s that these words became commonly used in everyday language, coinciding with the explosion of waste production. In 1970, graphic designer Gary Anderson created the iconic universal recycling logo based on the Möbius strip—which has only one surface and one edge—as part of a competition launched during the first Earth Day celebrated in Wisconsin. Originally intended for recycled paper products, the symbol later became widespread, used for all recycled or recyclable products worldwide. If the symbol is unaccompanied by any additional information, it indicates that the product is simply recyclable, while the appearance of a percentage signifies the proportion of recycled materials present. Its graphic simplicity is key to its success, allowing it to be adapted to all contexts and countries, to the extent that Gary Anderson realized the importance of his design when he spotted it on a trash can in Amsterdam a few years later!

The first to recycle material from waste after 1945 were the cardboard manufacturers, papermakers, and glassmakers, who were heirs to the old ragpickers. At that time, the Soulier Company, which would later become part of CGEA and Veolia, abandoned its declining ragpicking activities to focus on paper recycling by partnering with Cartonneries La Rochette. To supply its factories, the Soulier Company collected paper from shopping centers, supermarkets, and even schools after raising awareness of its collection among schoolchildren. After the 1973 oil crisis, glassmakers encouraged the French to recycle their glass bottles, as recycled glass required less energy. This was the first time such a recycling system was established for household waste. In 1976, an agreement was signed between the glass industry—represented by the Chambre Syndicale des Verreries Mécaniques de France—and the Ministry of Industry and Research. However, these initiatives still occupied a relatively small place compared to the explosion of what a 1972 television report called "lost packaging,"[51] i.e., non-returnable packaging. This accounted for 5 percent of packaging in 1960, 30 percent in 1972, and the journalist mentioned projections of 80 percent by 1980. From 220 kilograms of waste per year per person in the 1960s, France rose to 360 kilograms in 1990.

Faced with this trend, recycling efforts remained localized for a long time. It was only in the 1980s that things began to scale up in a very pragmatic way. "We were then able to establish supply chains," noted Martial Gabillard, Director of Resource Recovery at Veolia. "We identified sources, such as recycling wood, plaster, and even plastic. Our Waste Management division increasingly focused on sorting. If we saw that there was wood in the region, we would have a container for it. In recycling centers, we set up bins for green waste and, if necessary, for cardboard and scrap metal, which were used by cardboard manufacturers and scrap dealers. But it wasn't until the 1992 law that these flows were orchestrated."

Reflecting the spirit of the times and the simultaneous undertaking of other countries, the French Royal Law revamped the country's policy on household waste management. In addition to encouraging a reduction in landfilling and energy production from incineration, it advocated for waste reduction and valorization, driving the development of new facilities such as sorting centers and recycling centers. Like Germany from 1989 onwards, it further expanded the producer's responsibility, defined by the "polluter-pays" principle in the 1975 European directive, to household waste. It also fostered the creation of eco-organizations—federations of producers who assumed responsibility for the end-of-life

51 — INA Société. Vie moderne : les ordures [vidéo en ligne]. YouTube, July 23rd, 2012.

management of their products. "In the 1990s, local authorities no longer had the financial and technical means to manage waste, which was becoming more complex," explains Helen Micheaux, Associate Professor of Management Sciences at AgroParisTech. "Another solution had to be found. It was in this context that the idea of producer responsibility emerged."

"There was a real awareness. All these waste materials that we handled could be recycled. To achieve this, they had to be removed from household bins, implementing specific recycling channels for sorting and preparing them for reintegration," says Françoise Weber, Director of Extended Producer Responsibility Schemes in France at Veolia. "With eco-organizations, we started sorting plastic, cardboard, paper, and glass packaging." In the early 1990s, it was time to accelerate recycling efforts

Plastic Is No Longer Fantastic, Especially When It Comes to Single-Use

Plastic, it must be said, has taken a central position in the world of packaging and waste. Regardless of the oil shocks, plastic waste has increased from 4 percent of household waste in France in 1973 to 11.2 percent fifty years later. The pursuit of simplicity and convenience dominated an era waiting for a complete liberation from physical constraints, even though the seeds of the problems it caused were present from the beginning.

In a 1972 television report archived by INA, the director of a plastic packaging company extolled the virtues of his industry: "We have always thrown away packaging; remember the tin cans, the drums? The normal trend is to seek lightweight packaging that is not returnable, and plastic materials are ideal for this."[52] Plastic was fantastic, to the extent that a Belgian artist adopted the stage name Plastic Bertrand, in reference to the plastic garments worn by "punks," a movement that advocated for a break from the previous generation.

At the same time, downstream in the production and consumption system, the director of an incineration plant, a certain Mr. Fourment, began to lament the proliferation of plastic bottles in waste: "These bottles are indestructible, which is why, to some extent, when we talk about biodegradability, from our current state of knowledge, it's science fiction."[53]

Gradually, the importance of managing the environmental impacts of this new material is emerging. [Continued on page 162]

52 — *Ibid.*

53 — *Ibid.*

Jean Soulier

ADVOCATE OF WASTE RECOVERY AND SOCIAL ENTREPRENEUR

Born in 1868 in Meulan-en-Yvelines, Jean Soulier's journey is intertwined with the historical contingencies of the first half of the twentieth century. After studying at Lakanal High School in Paris, he joined the family waste recovery and valorization business to gain experience. However, his marriage to Emma Vachon led him to work with his father-in-law in Rouen. It was in this city that Établissements Soulier, master ragpickers, saw a significant part of its paper and textile recycling activity thrive on an industrial scale, even though the company remained relatively small.

In the 1910s, Jean traveled to the United States and Russia, which helped him build a network of contacts in the export industry that would serve him throughout his life. Unlike those waste collection companies that manage public services, the Soulier family directly profited from their trade: they purchased waste, sorted, valorized, and resold it at higher prices, generating revenue through the margins they obtained from these operations. Consequently, their success depended on the supply and demand of their products, and they only established themselves in regions where they believed there was a market.

In this context, the outbreak of World War I in 1914 temporarily halted their growth. For instance, a factory in Aisne was destroyed. In 1919, the family decided to reorganize the business, which refocused its operations in Rouen and transformed into the Société Anonyme des Anciens Établissements Soulier. Each brother focused on a specific activity: Jean became a wholesale rag dealer, and Eugène became a dealer in hides, leather, and horns. As the third administrator, Georges, Jean's son, was responsible for the recovery and shredding of rags and trimmings for paper mills. Their stores began to open throughout the city and its surroundings, and a large warehouse was established. Additionally, the family purchased real estate to accommodate workers who came to work, sometimes seasonally, in their factories.

The 1920s represented the golden age of the Établissements Soulier. With their growth, they acquired a large plot of land in Plaine Saint-Denis, a region of Paris already populated by many wholesale rag dealers. They established a branch there, which allowed them to expand their operations in Paris dealing in hides and leather, which they sold to shoe manufacturers in the capital and its suburbs. They subsequently acquired a business in Paris and workshops in Montreuil for the hides division.

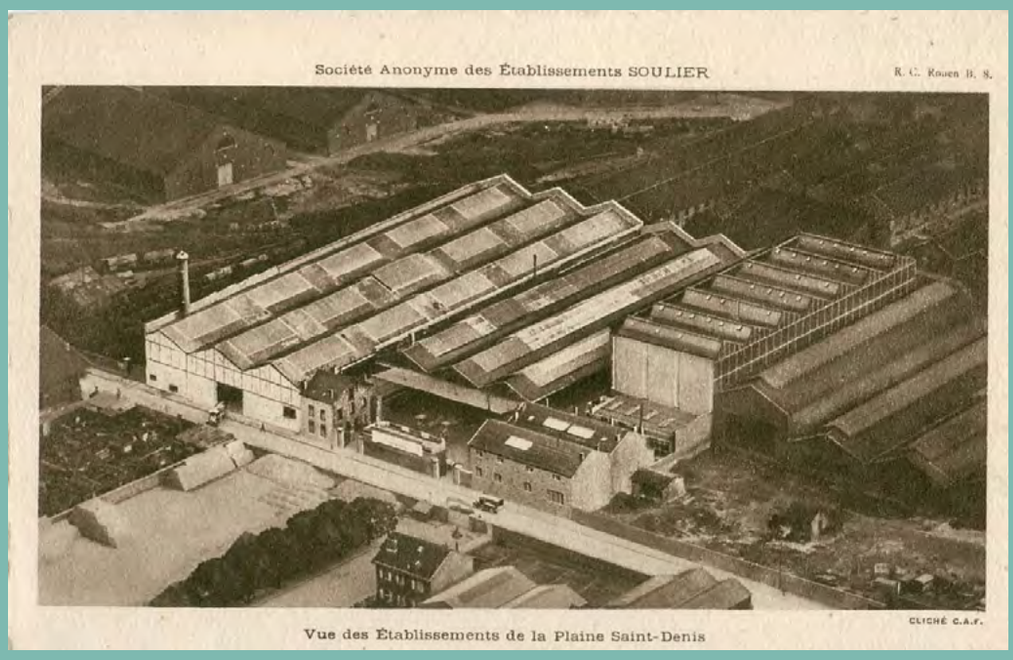
At that time, Soulier surpassed all other rag establishments in Paris, leading them to go public in 1924. Although the rag trade had faced complications in large cities since the introduction of garbage trucks that operated early in the morning, in small towns and villages it was still possible to collect from individuals who were happy to sell their rags, rabbit skins, animal bones, or anything

they had scavenged from illegal dumps. Despite being a notable figure in the city of Paris, a member of the general council since 1901, and although he resided there part of the year at 115 Boulevard Haussmann, Jean Soulier remained loyal to Rouen. As a radical-socialist, he also sought to improve working conditions in the recovery and sorting trades. He built housing for seasonal workers in his factories, promoted apprenticeships, established a mutual aid fund for the profession, and attempted to maintain year-round production to "avoid unemployment among staff." From 1921 to 1923, he oversaw the modernization of the old establishments in Plaine Saint-Denis, with special consideration for female workers, including a cafeteria, changing rooms, sinks, and showers.

Before the stock market crash of 1929, Jean Soulier embarked on another trip to the United States, continuing his efforts to expand exports. However, the global economic crisis quickly dashed his hopes.

In June 1930, Jean Soulier admitted that the company was facing a real setback, with merchandise dropping from 25,000 tons to 16,544 tons. The establishment turned to selling real estate to survive. Despite his social aspirations, Jean Soulier struggled to implement the social laws of the Popular Front in 1936, including paid vacations and a forty-hour workweek, which further destabilized an already fragile economic model. During World War II, he lost close collaborators, including his own son Georges. His workshops in Rouen were bombed. Établissements Soulier partnered with Cartonneries de la Rochette to create the Société Nouvelle des Établissements Soulier in 1946, a final attempt to overcome the crisis in rag, paper, and leather recovery, but the figures still did not improve. Ill and weakened, Jean Soulier delegated some of his responsibilities and passed away in 1954 in Rouen, where his company continued to collect and export rags as best it could. The establishments bearing his name were absorbed by the paper group Cartonneries de la Rochette in 1960, which, in turn, sold them to the Compagnie Générale des Eaux in 1990 as part of consolidating various waste management services. While this recycling activity remains fragile, it will allow the group to develop expertise in the field ●

Old postcard, edited by CAF Société anonyme des établissements Soulier – View from the facilities in la Plaine Saint-Denis, Paris, 1900-1920 ●



INDIA

In Chennai, the Informal Sector: A Key Link in Recycling

With a population of 1.4 billion, India has become a true demographic powerhouse, surpassing China. Alongside rapid urbanization and increased access to mass consumption, the subcontinent faces significant challenges in waste management. Historically, there have always been what are known as "informal waste pickers," and they still play a crucial role that needs to be taken into account by major companies like Veolia.

Indian cities produce 68.8 million tons of waste per year, a quantity that could increase by 133 percent between 2015 and 2041—a staggering figure, especially considering that 91 percent of the collected waste is not valorized and ends up in open dumpsites.

In India, post-consumer waste is sometimes managed by the informal sector, where men and women provide pre-collection and valorization services. According to a document from the

Centraider network, “these operators are often difficult to know and identify, as they make themselves less visible to avoid humiliation from the population or interventions from the authorities.”

This is why municipalities and even companies struggle to collaborate with informal sector workers. However, the stakes are significant, as highlighted by Kabadiwalla Connect, a technology-based social enterprise based in Chennai: “Leveraging the informal ecosystem of urban waste recyclers could reduce the amount of waste sent to landfills in Indian cities by 70 percent.”

Ragpickers, recyclers, and waste collectors often work in precarious conditions, but they play an essential role in waste management, helping to reduce the quantity of waste and minimize its environmental impact. In 2015, in the city of Chennai, Kabadiwalla Connect mapped and documented for the first time the “waste entrepreneur” or *kabadiwalla* in India. The study identified nearly two thousand of them in Chennai alone, where they collect over 24 percent of total recyclable waste, including paper, metal, plastic, and glass.

However, these actors face various challenges, including lack of visibility, incomplete information, and lack of official integration into the system. To address these issues, Kabadiwalla Connect has developed a platform to facilitate interaction between companies like Veolia and the informal sector. “Our goal is to strengthen the value of the informal supply chain,” explains Siddharth Hande, the founder and CEO of Kabadiwalla Connect. “One of our main initiatives is the establishment of a highly optimized plastic recovery facility supplied by the informal sector. We have a year and a half of experience with PET (petroleum-sourced plastic), and we achieve a high level of quality: 80 to 90 percent of PET is recovered on average, thanks to good sorting. The partnership with Veolia helps us improve the transformation and high-end valorization process.”

The company has set up a specific recycling infrastructure to obtain recyclable materials from the informal sector, initially focusing on plastic. The objective is to demonstrate that it is possible to obtain a significant volume of waste from the informal sector while benefiting from better prices, improved collection schedules, and a better understanding of the recycling market ●

It is in Germany and the Scandinavian countries that selective sorting has been most quickly embraced by the population in order to achieve this. Marc-Olivier Houel, General Manager of Recycling and Waste Valorization in France, as well as former Industrial Waste and Household Waste Manager in Sarre, remembers a time when everything had to be invented: "The Germans were pioneers in eco-packaging and the creation of eco-organizations," he says. "In September 1990, they established the first eco-organization in Europe: the Dual System Deutschland (DSD) and the Green Dot (Der Grüne Punkt)—the circular logo representing two intertwined arrows indicating that the company contributes to the treatment of packaging, which was later adopted by many countries, including France. Veolia, which has just entered the German market through the acquisition of the cross-border company Kléber, will play a central support role by advising cities on the implementation of the new regulations, distributing new transparent yellow bags, raising awareness among citizens through collection operators, and recruiting specific sorting ambassadors." Gradually, waste such as bottles, plastic films, yogurt pots, Tetra Pak packaging, and aluminum cans are collected and given back to the DSD: in the Saarland region, the quantities of lightweight household packaging collected and sorted have increased from zero in 1992, when the first selective collection system was implemented, to thirty kilograms per capita per year in 1995.

Granules manufactured from plastic waste.

However, in Germany itself, sorting alone did not immediately lead to recycling. The created plastic streams did not immediately find outlets that had not previously existed; instead, they led to the creation of these outlets, starting from the late 1990s. "It was like a startup," recalls Marc-Olivier Houel. "We were transforming our environment, and that of our clients, by putting pressure on the reuse of materials." The creation of a material resource allowed for the establishment of dedicated plastic recycling channels for horticultural pots or the automotive industry five to six years later. In 1998, Mercedes signed a framework agreement for collection from car dealerships and the recycling of damaged car parts (bumpers, glass, batteries, wipers, etc.). "We found recycling channels with Mercedes throughout Europe," recalls Marc-Olivier Houel. "The system was almost a closed loop. This is how we played a leading role in promoting the circular economy in Germany and Europe."

To expand these channels, partnerships with large companies are essential for exploring possibilities and finding new outlets for recycled plastic, which historically had been used mainly for non-technical applications such as recycled PVC pipes. This entails both "assisting industrial companies in changing their approach to raw materials, accepting small defects in recycled plastics," explains

Martial Gabillard, "and adapting to the most complex demands of companies that want to maintain high-quality products with specific technical specifications." Over the past twenty years, progress has been significant, to the point where, in 2021, the technological leader Thales partnered with Veolia to create the first eco-designed SIM card made from recycled plastic that meets the necessary requirements for strength, flexibility, and heat resistance.

Simplifying and standardizing the plastics used, especially those derived from recycling, is key to promoting the development of a circular economy.

In general, "there is a great deal of partnership work with eco-organizations. We need to work together to secure long-term material resources for innovative recycling industries," says Françoise Weber and Sophie Petibon, Commercial Director of Recycling and Waste Valorization at Veolia. This partnership also extends to eco-design in order to close the loops. Veolia encourages its partners to manufacture monoplastic products that are pure and simple, requiring fewer chemicals and less energy for recycling. "We offer consulting services to industrial companies on eco-design, as well as certification of the level of recyclability of their packaging," explains Sven Saura, Director of the Recycling and Plastics division at Veolia. "It should be noted that using a bottle made from recycled plastic emits 75 percent less CO_2 than one made from virgin plastic, and eco-design can further reduce this."

Simplifying and standardizing the plastics used, especially those derived from recycling, is key to promoting the development of a circular economy. This is why Veolia formalized its brand of circular polymers, PlastiLoop, in 2022. With PlastiLoop, the group offers a range of recycled products structured to meet the needs of various industries that want to reduce their use of virgin plastic. It is an offer tailored to the specific needs of each industry, from automotive to agri-food, aiming to establish recycling as a shared standard.

However, the challenge of plastic use and recycling is far from being solved. The world consumes over 350 million tons of plastic each year, and according to the United Nations Environment Programme, if nothing is done, this consumption figure could triple by 2060 and exceed one billion tons.[54] Currently, only 9 percent of plastic is recycled worldwide, almost 50 percent is landfilled, 19 percent is incinerated, and the rest ends up polluting the environment, sometimes in the form of micro- or nanoplastics. As an article in *Le Monde* published in 2023 states, "Every minute, the equivalent of a garbage truck filled with plastic waste is dumped into the oceans."[55] While technical solutions are being developed, regulations still have a role to play, as is often seen in the interaction between technology and the law. Mandatory incorporation of recycled plastic in products, such as the European Union's requirement for bottlers to incorporate at least 25 percent of recycled plastic into their bottles by 2025 and 30 percent by 2030, will be crucial.

Organic Valorization: From Agricultural Fertilizers to Animal Nutrition

Organic materials have historically been among the most valued waste, even before the advent of sanitary cities. Derived from urban sludge and emptied septic tanks, they were transformed through industrial processes into fertilizers or compost before the establishment of sewer networks, which made the sludge too liquid to be spread in fields, and the mass disposal of household waste, which gradually mixed and compacted the waste in garbage trucks, making their valorization nearly impossible.

With the resurgence of organic fertilizers in the twentieth and twenty-first centuries, the emergence of wastewater treatment plants, and the new distinction of waste streams, the recycling of organic matter regained precision, as seen in Milwaukee in 1926. Veolia mobilizes its sewage sludge

54 — OECD, press release, "Global plastic waste set to almost triple by 2060, says OECD", June 3rd, 2022.

55 — MANDARD, Stéphane. "Le plastique, une menace protéiforme", *Le Monde*, May 29th, 2023.

for this purpose and, in line with evolving regulations and needs, has established logistics that now allow for organic waste's return to the land. Biodegradable waste collected directly from the agri-food industry, large retailers, or restaurants is transported to composting units before being spread in fields.

Composting is the key method for valorizing this waste. It is a controlled biological process of degrading organic materials such as food waste, garden residues, and agricultural by-products. This ancient technique transforms the waste into compost, an organic amendment rich in nutrients that can be used as fertilizer to enrich agricultural soils as well as private gardens. Veolia has worked to optimize these processes and, most importantly, to operate them in accordance with the strict sanitary and environmental conditions defined by a series of laws and directives that consider the diversity of pollutants to be treated before returning waste to the soil.

The resurgence of organic valorization is more than a return to common sense. In the era of climate change, it is a means of capturing carbon in soil. "Biowaste allows us both to nourish plants with nitrogen- and phosphorus-rich fertilizers and to enrich soils with carbon," emphasizes Maelenn Poitrenaud, Innovation and Development Manager at Sede within Veolia, the entity dedicated to agricultural services in France. According to the Four per One Thousand Initiative, launched by the French Minister of Agriculture Stéphane Le Foll during the COP21 in Paris in 2015, an annual increase of 0.4 percent in carbon stocks sequestered in the soil could limit the concentration of CO_2 from human activities in the atmosphere. This represents significant potential, considering that in France alone, Sede composts 800,000 tons annually from its sixty composting sites. Moreover, in a nutrient-rich soil, plants grow faster and capture more carbon through photosynthesis.

Hence, the importance of a mass return to organic valorization. In France, the valorization of biowaste has progressed thanks to strict regulations promoting its sorting, separate collection, and appropriate treatment. Since January 1, 2012, large biowaste producers have been required to implement sorting and valorization solutions for these types of waste. Over the years, the AGEC (Anti-Waste for a Circular Economy) law has lowered the threshold so that by 2024, all producers will be subject to this obligation. Consequently, local authorities will have to provide individuals with separate collection and valorization solutions, notably through individual and collective composting. This challenge is significant, considering that currently half of France's biowaste ends up in the gray bin (destined for incineration), and only 30 percent of the population reports sorting their biowaste at the source.

Solutions exist, but they need to be generalized and provided with the means for deployment, both in France and worldwide, in order to increase their value.

The Development of Higher Value-Added Valorization

In contrast to the indiscriminate massing of waste streams, it is their increasingly minute separation that enriches the value of recycled organic matter. Veolia, in partnership with Angibaud and Recyfish, markets fertilizers made from fish waste. Primarily used in high-value crops such as viticulture and market gardening, the resulting "fish guano" is an organic fertilizer rich in nitrogen and phosphorus that also affects the microfauna and microflora of the soil, crucial for the optimal exchange of elements between the soil and the plant. Moving upmarket also requires mastery of new techniques. "Since its creation in 1979, Sede has acquired more expertise in sludge, drying, composting, and anaerobic digestion, enabling us to offer a more diverse range of biowaste valorization pathways today," explains Morgane Maurin, Secretary-General of Sede. "What we spread in the fields is a very diverse range, including high-quality compost and premium fertilizers such as Pro-Grow, Vital, and ADS." On Veolia's composting sites, as Guillaume Wallaert, former Director of Biowaste Solutions at Veolia, points out, "the AEROcontrol system, for example, accelerates the degradation of residues by

In the era of climate change, the resurgence of organic valorization is a means of capturing carbon in soil.

using a probe to measure parameters such as compost temperature to optimize air injection, improve the maturation process, and obtain higher-quality compost."

To better support farmers, Veolia has also pioneered innovations in precision agriculture. During spreading, it is also possible to observe how plants consume fertilizer and what their needs are, in order to optimize its use. "We apply biostimulants to the plant so that it can use the fertilizer to its maximum potential, allowing it to develop optimally and resist its environment," says Maelenn Poitrenaud. The same goes for soils: the Soil Advisor application helps farmers optimize fertilization by using organic fertilizers such as compost.

Veolia now even goes so far as to be a shareholder of Mutatec, a startup that transforms organic waste into proteins for animal nutrition through the breeding of black soldier flies, which produce insect protein concentrates from the waste material. "Bioconversion is a future activity that addresses the global food challenge and the objective of a circular economy by providing a better path for the valorization of organic by-products," emphasizes Jean-Christophe Perot, regional director for the Southeast region at Sede.

From Pollution Control to Valorization: The Emblematic Example of Hazardous Waste

The progress of recycling over the past few decades has been achieved through both the rediscovery of ancient practices and the implementation of new responsibilities, the development of new techniques, and the strengthening of environmental standards. The different material flows have thus seen

an improvement in their valorization, but perhaps none is as emblematic of the era and the DNA of Veolia as hazardous waste. Constituting a new and complex pollution, the treatment and recycling of these waste streams have developed from the entrepreneurial spirit of Veolia's teams. Jean-François Nogrette, director of the France zone and Special Waste Europe, is well acquainted with this story. "It was Veolia's Water branch that invented what became hazardous waste treatment in order to preserve its resource," he summarizes.

It all began when Bertrand Gontard, director of the water treatment plant in Méry-sur-Oise, realized that industrial effluents discharged into the Oise River were threatening the treatment of its water. To purify the river's water, he had to use even more activated carbon, and a shortage was looming, which would mean cutting off drinking water for the residents. To address the problem, he proposed that industrial companies treat their effluents directly in a specialized center, without waiting for the pollution to reach the river. "In his career, he also encountered a company called SARP," recalls Jean-François Nogrette, "which occasionally collected and pumped hazardous waste. He drew inspiration from this to create SARP Industries in 1975, a subsidiary of Compagnie Générale des Eaux," and established a first site on the Seine.

That same year, the first major waste law imposed traceability of toxic waste for the first time and applied the principle of extended producer responsibility. However, the economic model did not yet exist, as no industrial company wanted to pay for waste treatment. Therefore, it was Bertrand Gontard himself who convinced water agencies to finance treatment centers by levying a tax on industrial companies, according to the polluter-pays principle.

Based on the experience of the Compagnie Générale des Eaux in water treatment and its culture of engineers from prestigious government bodies, SARPI (SARP Industries) experimented, innovated, and sometimes faced failure. It should be noted that at that time, knowledge in this field was not well-developed. "Before 1975, hazardous waste, particularly from industrial and chemical activities, was not specially treated; it ended up in landfills or was diluted in watercourses," recalls Cédric L'Elchat, CEO of SARP Industries. Initially, SARPI attempted to incinerate hazardous waste in a furnace, but this was a resounding failure: the furnace was damaged by corrosion caused by acids released during the combustion of toxic wastes such as sulfur and solvents, which are now prohibited chemicals. However, SARPI retained the trust of the group, which provided it with the most valuable resource for developing such a complex activity: time. After approximately ten years, the subsidiary managed to treat the waste by continuously raising the bar of expertise, testing, and learning to characterize hazardous waste. "There is no client who accurately describes their waste," notes Jean-François Nogrette. "Some know exactly where it comes from, but for others, it is the result of mixtures. We have to perform chemical analysis in the laboratory to characterize the waste and prevent dangerous combinations. Thus, we have developed a genuine culture of waste chemistry, which later motivated us to move toward recycling it, as it is this intimate knowledge of the waste that drives us to extract more value from it."

"We have developed a genuine culture of waste chemistry."

Jean-François Nogrette

As a result of this progress, in 2022, Veolia not only treats but also valorizes hazardous waste, generating over one billion euros in revenue in France and over four billion euros worldwide.

While SARPI initially treated waste from large industrial companies, it is now active in various sectors, including "chemistry, petrochemistry, pharmaceuticals, vaccine manufacturers, and healthcare waste," as specified by Cédric L'Elchat. The automotive industry represents a significant branch of hazardous waste, particularly with the proliferation of lithium batteries to meet the growing demand for electric vehicles. The challenge in this area lies in their recycling, as end-of-life batteries contain valuable materials such as various plastics, solvents, electronic components, and even high-value metals like lithium, cobalt, copper, manganese, or nickel. SARPI will leverage the expertise of its site in Dieuze, Moselle, to recover these materials, supported by European regulations that will require

the inclusion of recycled raw materials in the production of new batteries. By 2031, batteries will need to contain 16 percent recycled cobalt and 6 percent recycled lithium and nickel, with these percentages increasing over the years.

Finally, while SARPI initially focused on water protection, it also addresses soil decontamination, investing in the remediation of industrial sites that are either at the end of their life or abandoned. “We deploy technologies to treat industrial brownfields,” explains Cédric L’Elchat. “We treat the hazards that can affect groundwater and surface waters, which may become contaminated by heavy metals such as lead or arsenic or by organic compounds such as hydrocarbons or methane.” Advanced technical solutions exist, including stabilization to reduce the mobility of pollutants in the soil, solidification to make the soil impermeable and trap pollutants, and thermal desorption to heat the soil and volatilize toxic components. For example, the latter method was used by Veolia to remediate the Fiat industrial site in Kragujevac, Serbia. Physico-chemical and biological treatments are also used, along with phytoremediation, which offers a more economical and ecological approach to soil decontamination. This technique is currently being used experimentally to treat contaminated soils around the Fukushima power plant in Japan.

Ultimately, whether it is paper, glass, plastic, organic matter, or hazardous waste, when we consider these materials, we are confronted with the finiteness of our resources. Waste treatment prevents pollution of the remaining natural resources, while recycling helps reduce extraction. It is essential and even virtuous in this sense, and there is still room for improvement. “In the Rennes metropolitan region, for example,” adds Martial Gabillard, “you are no longer allowed to bring grass clippings to waste disposal facilities; instead, composting is mandatory. We need to make these kinds of societal choices.” However, more fundamentally, since we cannot escape natural limits, we must remain aware and continue to steer mindsets toward greater resource efficiency ●

n_ FONTEVRAULT

Quelques réflexions sur SARP 2.

Actionnariat. Il n'est pas du tout souhaitable que SARP 1 soit actionnaire majoritaire de SARP2 pour de nombreuses raisons.

- Il faut dans un premier temps que les riverains ne soient effrayés à l'idée que nous allons leur prendre leurs travaux de pompage. Nous devons apparaître comme étant leur conseil et non comme leur concurrent.
- La coupure avec SARP 1 doit être très nette pour que le personnel transféré ait une nouvelle hiérarchie bien claire
- Il n'est pas souhaitable du tout que Claude ROBERT se sente un pouvoir trop fort pour régenter des accords de district qui seraient préjudiciables à SARP 2.

Un rapport 60/40 CGE / SARP me paraîtrait une bonne formule. La prédominance CGE n'est pas du tout gênante vis à vis de l'industriel, bien au contraire. Vis à vis de l'administration, cela ne change rien car tout le monde sait parfaitement que SARP = CGE.

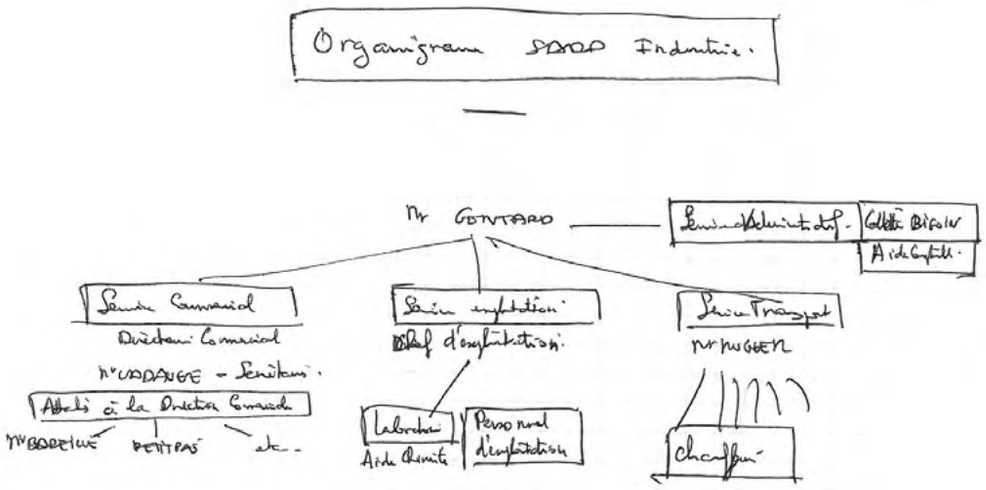
Expert Comptable Colette fera son affaire de la comptabilité sans difficulté. Je lui ai demandé d'embaucher une aide comptable sachant tapper à la machine.

L'expert de la SARP, Mr Collin pourrait être Commissaire aux Comptes, cela fera plaisir à Claude Robert.

Si des problèmes particuliers surgissent, Colette s'en arrangera avec l'expert de la CGE qui vous interviendra.

Banque. J'ai quelques connaissances à la Société Générale. J'aimerais la prendre à Nantes.

6 29 Mai 1985



Hazardous Waste: The Two Pages that Write the Beginning of the Adventure

In 1975, Bertrand Gontard initiated the establishment of SARP Industries by sending a letter to Bernard Forterre, one of the key lieutenants of Guy Dejouany, the CEO of CGE. The ownership structure and positioning of the business, the accounting organization ("Colette will take care of the accounting without difficulty"), the creation of a bank account, and the organizational chart of an activity expected to generate over four billion euros in revenue in 2022 were summarized in less than one and a half pages. Similar to a century earlier during the sanitation of cities, the attention was given to the reaction of vacuum truck operators who might perceive it as new competition. However, this time it was the internal vacuum truck operators within the company. At that time, the idea that a collective treatment center would not handle collection was a novelty. For Bertrand Gontard, working with all collectors, including the group's competitors, allowed for all human, technical, and financial efforts to be focused on treatment. This vision from the very beginning still persists today. For a long time, it was a significant competitive advantage. Nowadays, the entire sector has adopted this model, both in France and elsewhere ●

UNITED STATES

In Milwaukee, Nothing Is Wasted, Everything Is Transformed... into Fertilizer

Within the Great Lakes region—which represents 20 percent of the world's fresh water supply and 84 percent of North America's surface fresh water—Lake Michigan is the largest reservoir of fresh water in the United States. Along its shores, the city of Milwaukee and its industries, which have historically served as catalysts for its growth, depend heavily on water for production or transportation. Water is perhaps even more of a major issue for the region than elsewhere, and from its purification emerges a gem: Milorganite®, a high-quality fertilizer. But how can water be transformed into fertilizer? Here are some explanations. The first wastewater treatment plant in Milwaukee, Jones Island, was established in 1925. It was the first activated sludge plant in the United States—a biological process for wastewater treatment using microorganisms. And it was as early as 1926 that the Milorganite® production process was implemented and offered to fertilize the agricultural land in the region. Without delay, marketing, distribution, and commercialization of organic fertilizers derived from the plant followed the mass treatment of wastewater: it was a pioneering approach in the United States.

Today, approximately fifty thousand tons of Milorganite® biosolid fertilizer are produced annually at the Jones Island factory. This high-quality fertilizer has earned the "Exceptional Quality" label from the US Environmental Protection Agency (EPA). It is also certified by the Department of Agriculture due to its production from renewable sources. Initially intended for green spaces in the area, Milorganite® is now marketed throughout the United States, Canada, and the Caribbean.

Since 2008, Veolia has been responsible for operating the Milwaukee wastewater treatment plant with comprehensive activities on behalf of its client, the Milwaukee Metropolitan Sewerage District, and its 1.1 million inhabitants: wastewater treatment and recycling, biogas and electricity production, disposal, and, of course, the valorization of sludge with the production of Milorganite® biosolid fertilizer (Milwaukee Organic Nitrogen). Sensitized to biodiversity, the site's employees have even built a nest box on the Milorganite® production site to accommodate peregrine falcons. While this species' population had greatly declined after World War II, they have been expanding again since their protection in the 1970s—a symbol of humans' ability to act to protect the environment ●

AUSTRALIA

In Australia, Fertilizer Comes from the Salt Lake

Alternatives to synthetic fertilizers can come from recycling organic waste... or be extracted directly from a lake. This is the case in Western Australia, where the power of sunlight allows for the extraction of potassium sulfate (SOP), an essential fertilizer for plant nutrition, from Lake Way, which is rich in minerals. However, this requires advanced technological expertise: the country's first processing plant, operated by Salt Lake Potash Limited (SO4), has adopted crystallization technology developed by Veolia.

Lake Way is a shallow brine aquifer beneath a dry salt lake surface. Minerals that have been extracted from the lake's catchment area have been flowing into it for millions of years, resulting in its particularly rich concentrations of potassium, one of the three essential nutrients for plant growth, ready to be exploited. "The main advantage of potassium sulfate is that it does not contain chloride," emphasizes Tony Swiericzuk, former CEO of SO4. "The term 'potash' usually refers to potassium chloride, the benchmark for such fertilizers, but it is not well-tolerated by the poor, arid soils of Australia, the Mediterranean, Africa, and the Middle East. It also affects the taste and color of certain cash crops such as nuts, berries, citrus, and other fruits."

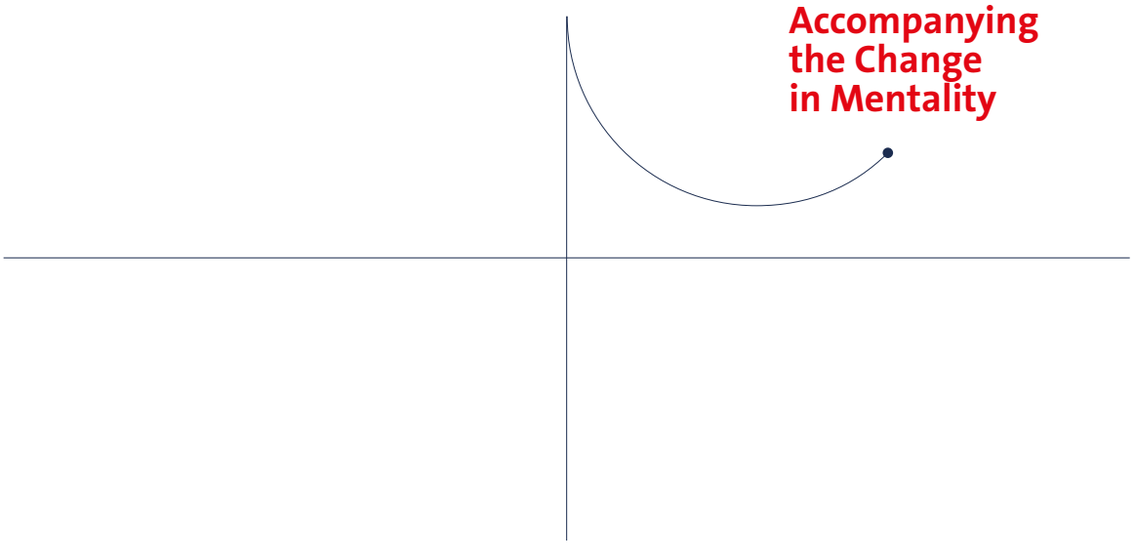
After extracting the brine, removing contaminating salts, and allowing the water to evaporate through the action of the sun, the concentration of potassium sulfate gradually increases before entering the crystallization stage. "To convert the collected salts into high-quality potassium sulfate, Veolia has designed two crystallizers. One is used to grow and purify potassium sulfate crystals, and the other is used to produce secondary schoenite salts, which are recovered from the recycled potassium sulfate mother liquor. These salts are then combined with primary schoenite salts and added to the SOP crystallizer to maximize potassium yield," explains Jim Brown, former Executive Vice President of Veolia Water Technologies Americas.

The goal is to deliver 245,000 tons of potassium sulfate per year in regular production. This is a welcome addition for Australia, which imports almost all of its SOP by ship from Belgium and Germany, and it provides a new source that offers proximity, which is important for customers in Southeast Asia and Australia ●

Story
10

From Sorting to Waste Reduction

Accompanying the Change in Mentality



Certain African kingdoms in what is now Burkina Faso had a strange proverb: "One recognizes a great leader by his garbage." Garbage never ceases to be socialized, and the vassals of the Mossi kings were indeed obliged to bring their own garbage to the entrance of the capital to create a growing heap of garbage, demonstrating the extent of royal power. Therefore, throwing away as little waste as possible could be a sign of wealth, rewarded with new symbolic gratifications, or even a new business model. In an era where all modern societies are facing the same challenges and where learning now circulates from the Global South to the Global North, discarding as little waste as possible would entail a profound change in mentality that would break with what Georges Bataille called "the accursed share of modernity," meaning humans' dissipation of the energy not necessary for the functioning of life •

GRÉGORY QUENET

In 1883, the famous decree by Eugène Poubelle already provided for selective waste sorting at the source: one container for organic waste, one for paper and rags, and one for glass, earthenware, or oyster shells. Little accustomed to the act of sorting, which was previously carried out by scavengers, particularly ragpickers, Parisians quickly abandoned this practice, which no one would reconsider for over a hundred years. In 1992, the Royal Law sought to once again encourage local authorities to implement selective sorting of packaging in order to promote the recycling of raw materials, but the integration of the spirit of the law into customs ultimately took about thirty years. It must be said that its implementation is particularly complex: sorting initially required distinguishing between different types of packaging, as not all of them are recyclable. Initially, sorting rules were limited to bottles, PET resin containers (used for example in mineral water bottles), and HDPE resin, used for laundry detergent bottles. While this sector has been successful, it "has not allowed for the development of recycling of other plastic packaging such as trays, pots, or films," explains Citeo,[56] the eco-organization specializing in packaging ●

The Emergence of New Professions and a New Sensitivity

Despite the difficulties, the law will soon lead to the emergence of new professions related to sorting and recycling. "The services responsible for household waste in Rennes Métropole were managed by three people in 1993!" exclaims Martial Gabillard, Director of Flow Recovery at Veolia in France, while today two hundred people work in this sector. Thousands of jobs have been created, including environmental engineering and technician specialists, to meet the new demand. In the early 1990s, the Compagnie Générale des Eaux, which also manages various companies in waste, transportation, and energy, struggled to find the right candidate profiles to fill the new job openings in these fields because "there were only two small study programs on collective heating professions, almost none on sanitation professions, and absolutely none on transportation and waste collection," recalls Hilaire de Chergé, former Director of HR Performance at Veolia. Veolia inaugurated a campus in Jouy-le-Moutier in 1994, which offers diploma programs. "It was truly original," adds Jean-Marie Lambert, former Deputy General Manager of Veolia in charge of HR. "At the time, these programs did not exist, so we reached an agreement with the education authorities and universities to create diplomas in these professions, from vocational training to master's degrees, with apprenticeships and alternating education."

In the mid-2000s, Veolia campuses trained approximately six hundred apprentices each year and hosted fifteen thousand

56 — Citeo, "Simplification du tri en France : on fait le point !", *Le Mag Citeo*, January 3rd, 2023.

people for internships. “In line with the initial motivation, this considerable development of internal training improved the image of our professions and facilitated recruitment,” emphasizes Hilaire de Chergé.[57] “Contrary to what many feared, it also contributed to staff retention.” With the professionalization of the sector, awareness and education have made waste sorting a relatively ordinary gesture today. It has even become emblematic of our ecological awareness, the minimum commitment of citizens to the environment. According to the Elabe Veolia 2023 barometer of ecological transformation, 84 percent of French people are willing to sort their waste more to fight pollution, a figure that is roughly the same as the global population. “The integration of users, solicited to participate in sorting for recycling, has continued by involving consumers, who are responsible for their consumption practices,” adds Laurence Rocher, Associate Professor in Urban Planning and Development at Lyon 2 University.[58] In other words, selective sorting alone is not enough to solve the waste problem; we also need to change our consumption habits.

In 2008, a European directive translated this emerging awareness into law by establishing a hierarchy of waste management methods: prevention, preparation for reuse, recycling, other forms of valorization, and finally disposal when no other option is available. In summary, the best waste is the waste that is never produced, and the concept of waste reduction, or even frugality, has entered into the discussion.

The term “frugality” refers to a simpler way of life based on frugal consumption in all areas. In her article “Towards a Society of Frugality: Conditions for Changing Consumer Behavior,” written for the Veolia Institute’s journal, Valérie Guillard writes: “The negative impact of our behavior on the environment implies going beyond the circular economy (reuse, recycling, and eco-design) toward more frugal lifestyles. Frugality is a way of life that does not only consist of consuming better but, above all, consuming less.” For the doctor of management sciences, this represents a radical change in consumers’ way of life and their relationship with objects: “Frugal acquisition involves rethinking the type of objects to acquire, and the manner and places to do so. Buying frugally also means buying quality, durable products, questioning their materials. This involves not only thinking about the object but also feeling it, engaging not only representations and beliefs but also knowledge and sensory perception.”

Therefore, there is a new quantum leap to make from sorting to waste reduction. If we have managed to reject the society of disposability, will we be able to do the same with the society of wastefulness? What have been the drivers of the adoption of selective sorting by French society? How can we push further by encouraging a different approach to waste? In countries around the world, we are starting to see this change in mentality, which is gradually altering our perspectives on waste production. Zero waste, bulk shopping, reuse, repair, rental, lending, bartering—the new consumption practices are numerous and adaptable, with a solution for every situation. How can we generalize these practices among the population while ensuring the continuity of a prosperous life? These are the challenges that our societies face today.

The Difficult Transition to Sorting: The French Example

The transition from conviction to action is sometimes difficult, and it was particularly difficult in France. On August 27, 1998, the newspaper *Le Monde* printed the headline “Selective Waste Sorting Struggles to Become a Part of French Culture.” The first time that the French began sorting was in

57 — DE CHERGÉ Hilaire. “Les Campus Veolia : de l’ambition dans la formation”, *Le Journal de l’École de Paris du management*. 2010, 37-43.

58 — Journal of the History Committee of the French Ministry of Ecology, Sustainable Development and Energy, *Pour Mémoire*, no.12, Autumn 2013.

1977 with experiments in glass sorting, followed by old newspaper sorting in the late 1980s. More significant initiatives emerged in the early 1990s, but by 1998 only 6 percent of waste was being sorted in France.

The Limits of Prioritizing Local Action

Local authorities are at the forefront of waste management and the implementation of selective collections. However, only ten thousand out of France's thirty-six thousand municipalities have done so, which is less than one third. It must be said that the selective sorting system requires significantly more funding than landfilling, which has been prevalent in most rural areas, and municipalities often hesitate to assume this cost. Hence, there has been a sometimes excessive reliance on voluntary drop-off from users, a system that is not always effective.

The article in *Le Monde* also highlights the organizational complexity of sorting and how it weighs on the behaviors of users: "Selective waste sorting imposes a daily discipline. How can we encourage users to remove the caps from bottles, often made of a resin that differs from the container's resin"—especially when the rules can vary from one municipality to another?

As Franck Pilard, Sales Director at Veolia Recycling and Waste Recovery, explains, "In line with French decentralization, municipalities and intermunicipal authorities were given latitude to act. Each one could sovereignly decide on the best collection scheme. As a result, due to historical and contingency reasons, we have had various configurations. As a result, when you moved or went on vacation, there was no continuity in sorting instructions, and even the colors of the bins were not harmonized." Some municipalities provided special blue bins for paper recycling, while others did not separate paper from the yellow bin. These blue containers would then accept all types of paper...except for receipts, envelopes with windows, photo paper, wallpaper, or gift wrapping paper. For packaging, much of which is made from composite materials, there have long been numerous exceptions depending on where you live: egg cartons, yogurt pots, toothpaste tubes, plastic films, plastic bags, pizza boxes...all of it created confusion for consumers when it came to their bins. Not to mention a whole list of specific waste that consumers still have to take to dedicated collectors: medications, batteries, light bulbs, clothing, toys, electronic waste, etc.

© Lara Jameson

Standardization, Transparency, Education, and Incentives: Keys to Success

"The clearer, simpler, and more stable the instructions, the more they can be understood and applied by everyone,"

The selective sorting system requires significantly more funding than landfilling.

argues Matthieu Carrière, head of Sorting and Biological Treatment at Veolia Recycling and Waste Recovery. Since 2009, there has been a national project to simplify sorting by allowing residents to sort all their packaging in the same way throughout France. The Energy Transition for Green Growth Act of August 17, 2015, enshrined a timetable leading to the generalization of sorting in 2023 for almost all French territories. By instructing the entire population to place all packaging, without distinction, in the recycling bin, this simplification allows everyone to think less when disposing of their waste. As a result, an additional three kilograms of packaging per inhabitant will be recycled each year.

It has also been necessary to make sorting tangible for the general public—and, in this case, the local approach has made a difference. Since 1993, the sorting and waste recovery center Arc-en-Ciel 2034 has been designed by Veolia as both a model factory and an educational showcase for the region. “We have involved schools in the area so much that it has left a lasting impression on the local community,” explains Annäig Pesret-Bougaran, the center’s director. “In Nantes, everyone knows the Arc-en-Ciel facility because they visited it when they were younger. That’s what changes mentalities and adds value to our professions.” The center welcomes seven thousand visitors each year and regularly updates its infrastructure, including an amphitheater for conferences, an exhibition gallery, updated tour circuits, a welcoming parking lot, and an ecopole with multimedia games. “People are surprised to see what happens in the sorting center,” she adds. “Most have no idea about the technology or human resources required to manage their waste.”

The contribution of the behavioral sciences is also decisive, and Veolia does not hesitate to incorporate this into its awareness policy. Whether working with municipalities or establishments receiving the public, the group uses mechanisms validated by scientific and psychological approaches: the use of a single logo understandable to all, national color harmonization, elimination of the vague term “packaging,” display of sorting instructions on the side of the bin, on the lid, and inside the lid, favoring short, clear messages understandable by everyone, and even the use of realistic photos and pictograms, which are more effective than text. Franck Pilard from Veolia also mentions techniques increasingly used to encourage intelligent sorting, such as “revending” or “nudging.” The first method involves returning plastic bottles or cans to a collection point in exchange for vouchers or a donation to a charitable organization. It can also simply involve reintroducing the practice of depositing certain packaging, successfully implemented in Germany, Sweden, and Denmark. As for nudging, it involves discreet and playful interventions aimed at influencing people’s behavior. In Lille, for example, amusing stencils guide users to the bins, while in London, a nudge suggests “voting” by throwing cigarette butts into the bin corresponding to their choice of answer to a popular question (such as, “Who is the better player: Messi or Ronaldo?”).

In addition to these incentives, collection services can influence residents’ behavior daily: not collecting a bin, placing a sticker on a poorly sorted bag, and providing prevention measures to residents. The digitization of services also promises good results, as seen with the Cœur Côte Fleurie intermunicipal community, which, with the help of HomeFriend, a Veolia subsidiary, launched the creation of the chatbot “Sophie” in 2018. Digitization, coupled with artificial intelligence, also allows us to adapt services to specific behaviors. In Angers, dozens of voluntary drop-off points have been equipped with connected sensors, and the data collected in real time helps the authorities optimize their management and even rethink their location to match the true expectations and needs of residents. By providing flexibility in deposit rules and authorized hours, for example, it will be possible to further encourage citizens to sort. And by improving public lighting or integrating video surveillance devices at collection points, residents, elderly individuals, and single women will be more inclined to make their deposits in the evening. [Continued on page 180]

From Early Machines to Intelligent Robots, Waster Sorting is Becoming Easier with New Technologies

The first step in sorting is not enough to ensure the recycling of our waste: after the citizens do their part, specially employed people must carry out additional sorting to make the recycling possible. Over the course of a few decades, this second step in waste sorting has become more refined, capable of distinguishing different types of materials on the line with surgical precision. However, the laborious nature of sorting jobs remains a constant challenge: from Parisian ragpickers in the nineteenth century to operators in modern sorting centers, the principle has not changed much: you have to get your hands dirty. To improve the lives of its employees, Veolia has been investing in industrial robots equipped with artificial intelligence in recent years.

While waste sorting plants were minimally affected by the industrial robotics revolution in the 1960s and 1970s because most tasks were too complex for robots at the time, they did integrate mechanical machines to separate waste. The first of these machines used by operators, such as the trommel or the "overband" magnetic separator, date back to the mid-twentieth century. Trommels are cylindrical and rotating sieves that allow waste to escape based on their dimensions. The overband consists of an electromagnetic magnet placed above a conveyor belt. When waste passes under the magnet, ferrous materials are attracted and captured by the magnetic force. Since 1984, some sorting centers have also been equipped with a Foucault current separator, which is used to isolate aluminum from other waste.

Starting in 1992, the Royal Law, which promotes selective waste sorting in France, has advanced sorting techniques. Faced with the challenge of increasing sorting rates and volumes, companies have developed solutions to save time and improve efficiency, thus enhancing working conditions. In the 1990s, the introduction of bag openers gradually replaced manual bag opening, an intense and time-consuming task. With the use of rotating blades, serrated rollers, or claws to cut and tear bags, machines automated this step and relieved workers' burden. At the same time, infrared sensors were developed to refine the separation of material streams. As each material emits a certain wavelength of infrared light, sensors can detect and direct them to the next sorting phase to facilitate recycling.

Less Strenuous Sorting Jobs in the Future Thanks to Robots?

We all know Wall-E, the famous robot from the Pixar movie whose mission is to clean up the endless waste on planet Earth while humanity has evacuated to space. It's hard to say if Wall-E is a distant cousin of Max-AI, but their work is complementary! Developed by Veolia, this robot operates using artificial intelligence, which controls a robotic arm and a camera. Through machine learning, Max-AI sorts various materials with a performance of 3,600 movements

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per hour, compared to 2,200 for a human, with a 10 percent error rate. Currently, Max requires a human in order to be trained and, most importantly, to verify that it has done its job correctly. As Annäig Pesret-Bougaran, director of the Arc-en-Ciel plant in Couëron managed by Veolia, confides, "Even though artificial intelligence is the ultimate step, we still need sorting operators: we don't yet know how to replace humans."

In a similar vein, the Rob'Inn robot promises to assist workers in furniture sorting centers. With its robotic arm and two cameras, this giant robot operates through a three-dimensional analysis of photographed images, which are then sent to a tablet for an operator to select the objects to be sorted. In Veolia's plants, Rob'Inn doubles the productivity of sorting centers and enables 100 percent rates of material valorization.

Robots are seen as an opportunity for operators to enhance their skills and address increasingly complex sorting demands. Marc Brunero, Technical and Performance Director of Recycling and Waste Recovery (RVD) in the Center-West region at Veolia, points out that "the extension of sorting instructions to increase the quantities of recycled materials has brought us more contaminated waste in selective collections, which is more challenging to sort."

Rob'Inn and Max-AI are solutions that alleviate the strenuousness of the job for workers and enhance their safety, without completely eliminating the need for human expertise. They enable employees to acquire new skills and evolve in their careers; cabin sorters have become machine operators and then operators of robotic lines. As Marc Brunero further explains, the robotic solution "addresses our main objective: to continue simplifying the sorter's actions, which improves workplace safety while boosting the performance of material sorting flows."

This is how the act of sorting has gradually become established in France, as well as in many other countries, as the most obvious gesture for protecting the planet.

From Waste Reduction to a New Relationship with Objects

"Even though the amount of household waste per capita in France has been holding steady or even decreasing (around 350 kilograms per year per person), the overall quantity of waste and its unequal distribution continue to increase. Citizens of the United States produce twice as much household waste as inhabitants of Europe and three to four times more than those in poor countries," note researchers François Jarrige and Thomas Le Roux in an interview published in the magazine *Mouvement*.[59] According to a report by the OECD published in June 2022, plastic waste could even triple between 2019 and 2060, from 353 to 1,014 million tons. This growth in waste is accompanied by a global increase and instability in the prices of raw materials since the war in Ukraine, which causes supply difficulties for various industries. Under these conditions, sorting and recycling are crucial, but they are not enough to solve the waste issue.

Energy on Earth is not unlimited, and materials cannot be recycled indefinitely. "For some materials—plastic, paper, and cardboard, for instance—there is significant degradation over the course of the recycling cycle," explains Flore Berlingen, essayist and former director of Zero Waste France.[60] "This means that we have to add virgin material, and we cannot manufacture the same object from the initial one. Furthermore, even for materials that recycle better, such as glass or aluminum, there is still resource consumption in terms of energy or water that needs to be taken into account." Flore Berlingen therefore advocates for the improvement and standardization of recycling, with more mono-material products, but also for an end to the consumption of disposable products.

Since the 2000s, waste reduction has become a focal point for the European Union, which included it in its 2008 directive. In France, the Anti-Waste Law for a Circular Economy (AGEC) of 2020 is based on the hierarchy of the 3 Rs: reduction, reuse, and recycling. This law crystallizes a trend that is already under way in a small sector of society and is symbolized by the zero waste movement, which has been spreading since the 2010s. Contrary to what its name suggests, The intention of zero waste is not to eliminate waste entirely and immediately, but rather to actively pursue and work toward achieving this ideal. The French figurehead of the movement is Béa Johnson. This famous blogger became known for her book *Zero Waste* (2013), in which she explains how she and her family produce only one jar of waste per year and have achieved a 40 percent reduction in their expenses. Jars and bulk items replace disposable supermarket packaging, solid soap replaces shower gel bottles, reusable cotton swabs are introduced...disposables disappear from the homes of followers of this lifestyle. In France, there is a certain enthusiasm for it, as 81 percent of French people had already heard of zero waste by the year 2020, and for 91 percent of them, reducing waste is important.

However, mentalities are struggling to change in this regard as well. Decades of overconsumption, the decrease in the price of certain daily products, and the allure of ready-to-dispose items continue to generate wasteful practices, sometimes unbeknownst to consumers themselves. During her studies on consumer psychology, which resulted in the collective work *From Waste to Sobriety* (2019), Valérie Guillard observed this form of denial among people. "Today,

The act of sorting has gradually become established as the most obvious gesture of protecting the planet.

59 — LE LAY, Stéphane. "Le rôle des déchets dans l'histoire : Entretien avec François Jarrige et Thomas Le Roux", *Mouvements* (2016): 59.

60 — MAURER, Mathieu. "Le recyclage est-il vraiment efficace pour lutter contre la pollution ?", *18h39.fr*, July 13th, 2020.

we mainly associate waste with food waste," she says. "It is not a term we use for objects; people believe they don't throw them away, and in a way, it's true. They accumulate them without repairing them—they put them aside—so for them, it is not considered waste. But in reality, they don't give away their possessions and they don't reuse them, so yes, it is waste."

According to Valérie Guillard, we have used objects too much as a way to socially distinguish ourselves, to define ourselves. Even though disparities exist between cities and rural areas, everyone wastes in their own way. The researcher explores the new relationships with objects that cross certain layers of society, especially the care we give to things. "We have lost the habit of maintaining our possessions," she notes. "We don't know how to do it anymore. Many things are so cheap that it is not profitable to repair them. And it takes time to mend clothing! Who still knows how to do that? We don't think about it because we are not used to doing it: cleaning the washing machine filter, inflating bicycle tires, greasing the chain." Despite everything, mentalities are starting to evolve, and practices such as borrowing, donating, or renting objects are emerging and gaining media attention. "Sustainable consumption also means sharing," explains Valérie Guillard. "It is local, within a given area. Once again, it does not yet correspond to our consumption norms, even though initiatives exist."

This is the case for coworking spaces and "repair cafés," these new collaborative repair workshops that are spreading throughout the country with the support of associations, local authorities, and the state. The Recyclerie, a coworking space located in the Eighteenth Arrondissement of Paris, for example, has hosted L'Atelier de René ("Rene's Workshop") since 2014, in partnership with Veolia. The objective of this place is to fight against planned obsolescence by repairing everyday objects, lending tools, and sharing knowledge. After five years of existence, L'Atelier de René has repaired over three thousand small household appliances. These solutions are also being developed in waste sorting centers or energy recovery units, such as in Bordeaux. In Floirac, more specifically, Veolia launched a new kind of waste disposal facility, Recycl'Inn, in 2014, which includes an area for recovering used household items that might have a second life, as well as a specific reception area for used furniture. This is a way to connect with the local community and invest in these sites as integrated living spaces in the urban landscape.

"So here we are at the heart of tomorrow's challenge: prevention and reuse," notes Franck Pilard. "But to do this, we cannot

collect as we used to; we need to do better with less. We talk about capture rather than collection. If I want to reuse an object, I need to preserve its physical integrity. Historically, we were paid by the ton and not for prevention: we take bins, empty them, remove the waste, and compact it toward the sorting center. But if I compact it, I cannot move toward repair, reuse, or recycling."

So how do we proceed? Change the methods of collecting household waste, for example: managing it by bicycle, by boat, or even on horseback. Reduce the frequency of truck visits, which sometimes occurs five days a week in certain cities, while others—certain neighborhoods in Rennes or Nantes—only have weekly collections. "We can also reduce the size of the bin," adds Franck Pilard, "but we must be careful to remain socially equitable; we must do it according to the types of families. We must move toward a closer relationship with the citizens, because they hold the waste. If we want them to reuse, we have to work with them and understand their behaviors."

A first European directive in 2008, followed by a second in 2018, came to support this objective, encouraging European states to implement waste pricing systems based on volume. Today, six million French people are subject to incentivized pricing, a number that is expected to increase, provided that there is improved consultation with residents and corresponding investments are made, ensuring social justice is preserved. In this regard, Veolia offers various types of solutions: billing per collection or by weight. The former is calculated based on the number of times your bin is collected, while the latter is based on the weight of your trash—but it costs more for the municipality and can lead to uncivil behaviors and possible

disputes. In any case, the more waste you bring to compost, recycling centers, or collection points, the lower your bill will be. These incentive mechanisms need to be adapted to local specificities, including housing typologies.

Finally, French legislation once again demonstrated its proactive capacity with the AGEC law, which, while transposing European expectations into French law, goes further by making “waste” the central axis of its regulations, with the word only mentioned in relation to food waste. Adopted in 2020, it aims to transform our linear economy, (which follows the "produce, consume, dispose" model), into a circular economy. These objectives include five challenges: moving away from disposable plastic, providing better information to consumers, combating waste and promoting solidarity-based reuse, addressing planned obsolescence, and improving production. These are challenges to be met by individuals as well as all sectors. “We may have fewer and fewer collection personnel,” concludes Franck Pilard, “but more and more professionals trained in reuse, repair, and selective sorting to support citizen actions. This also means fewer arduous jobs and more that involve skill development.”

In short, the discussion is finally about making the waste we produce visible in order to extract its true value, whether as secondary materials or as energy, but also to view it once again as objects that we can repair, exchange, or donate. It is nothing less than changing our worldview. It is an ambitious and exciting program ●

“We must move towards a closer relationship with the citizens, because they hold the waste. If we want them to reuse, we have to work with them and understand their behaviors.”

Franck Pilard

NIGER

In Niamey, a Female-Led "Third Space" for a Sustainable Future

In 2014, La Recyclerie was established in Paris. Dedicated to the circular economy, it quickly became an emblematic place in the French capital, with Veolia as its main partner, and it inspired Niger to open its own "third space." Created in 2018 by the Veolia Foundation, the Société d'Exploitation des Eaux du Niger—a local subsidiary of the group—and the international network Empow'Her, L'Oasis is a space dedicated to women's entrepreneurship, the circular economy, and eco-responsibility.

While the initial intention was to train Nigerien women to find their place in their country's financial life, L'Oasis in Niamey aims more broadly to educate the population about the importance of sustainable development and resource preservation. It serves as a unique and genuine place for exchange and sharing for women entrepreneurs, as well as a space for training in economic innovation, notably through its incubation program. The botanical garden and ecological vegetable garden, on the other hand, provide informal contacts while raising awareness of environmental issues.

In less than a year, over 2,500 people have gathered around its events, and no less than 700 women have benefited from entrepreneurship training to launch their own businesses. Some of them then return to share their experiences, as well as their knowledge and skills, within their community ●

EMPLOYEE'S TESTIMONY

Ariska Rosalia

Employed at Veolia since 2019

INDONESIA

Ariska Rosalia, sustainable development manager of the plastic recycling site in Surabaya, Indonesia. Initially pursued a teaching career, but shifted her focus toward corporate social responsibility (CSR). After spending three years in the pharmaceutical industry, where she concentrated on health, social issues, and education, she joined Veolia in 2019 as the Sustainable Development Manager in Indonesia. She was attracted to the company's reputation as the largest player in polyethylene terephthalate (PET) recycling in Indonesia. At the plastic recycling site in Surabaya, Ariska and her colleagues give a second life to plastic bottles.

What does your daily work at Veolia look like?

"Veolia is a key player in the circular economy. We recycle used bottles into food-grade PET plastic pellets, transforming old plastic bottles into new ones. This concept of the circular economy sets an example for other companies.

"We must take responsibility for our waste and production, avoid environmental damage, and find ways for our waste to become raw materials again. At Veolia Services Indonesia, my mission includes implementing training programs for our suppliers. The objective is to enable them to act ethically and adopt sustainable and responsible practices."

How does your work contribute to addressing the ecological challenges we face?

"Treating waste as a resource is a way to ensure sustainability and resource efficiency. It also involves changing our perspectives and attitudes. What we once considered useless and valueless waste that needed to be disposed of becomes valuable and useful for designing new products. It can thus gain additional value in terms of economy and usage. Waste management is a major challenge for our planet. Recycling helps minimize waste production, pollution, and energy consumption."

"This position also allows me to work with local communities, which is one of my passions," she rejoices.

How is Veolia's long history an asset?

"Having a long history is one of the most valuable assets for an organization. It allows for the emergence of stories and individuals that define and contribute to shaping its corporate culture, values, mission, identity, purpose, and reputation. It also builds trust with stakeholders.

"However, in my opinion, Veolia's greatest asset lies in its ability to develop access to resources while preserving and renewing them through its three complementary activities."

ENERGY

CHAPTER 3

Contrary to what one might believe, modern industrial civilization is not the only one built on energy. Long before, mechanical energy (from human and animal muscle power), fuel (from wood), as well as solar energy (which makes plants grow) and wind energy (which powers ships) had already contributed to the rise of great human societies. The difference lies in the astronomical amount of energy consumed since the Second Industrial Revolution. However, this growth has its limits, as highlighted by various crises, including wars, oil shocks, and natural disasters. Moreover, CO_2 emissions from fossil fuels are dramatically warming the planet, posing a crucial question: how can we maintain a prosperous society without destroying the planet? For Veolia, the answer lies in solutions that promote both energy efficiency and the decarbonization of our energy system •

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Providing Energy

From Supply Security to Energy Sovereignty

The advent of individual comfort has made us forget how, for centuries, private needs were not a priority and received little innovation. When caminology—the science of chimneys—experienced a technical revolution in the 1750s with the elevated and narrowed hearth, the energy efficiency of fireplaces doubled to a meager 15 percent. Industry, particularly arsenals and forges, was prioritized, and cold was a common experience, even for the affluent. Energy sovereignty was no longer a priority by the 1980s, thanks to the use of resources from friendly countries and geographic diversification of supply sources ensuring the stability of the global market. However, the war-induced ecology caused by the conflict in Ukraine has brought back forgotten questions that are unlikely to disappear, even if the growth of global needs contradicts the imperatives of climate change •

GRÉGORY QUENET

With the First Industrial Revolution, the development of our modern societies was made possible by access to coal, an energy source that was more abundant and less costly than previous ones such as water, wood, and horses. This transition to a radically new world first occurred to address supply difficulties: the wood crisis, driven by population growth and increased needs, accelerated the use of "charcoal from the earth," or fossil charcoal: coal. Historian Fernand Braudel recounts in *L'Identité de la France (The Identity of France)*: "Our forests, although abundant, could not withstand intensive exploitation: wood was used for heating houses, cooking, and, in the form of charcoal, for the production of cast iron, iron, and steel. It was also an essential material for clog makers, woodworkers, and the construction of cars, plows, and houses, as well as boats and ships. Blast furnaces, forges, and foundries were not the only 'fire factories'—we must also include glassworks, breweries, and lime kilns."[61] Moreover, for the historian, if England "used stone coal early on, even just for heating London, and if it proved to be a pioneer in the use of coke, it is partly because it was forced to do so due to the depletion of its forest resources." The decrease in the cost of coal only came later—and it then surpassed wood before being joined by oil and gas. However, let us retain the essential point from this original moment: it is need that, once again, before technology or even cost, became the primary driving force behind technological and social development.

Even in an era of abundance, the importance of securing the energy supply has not disappeared; on the contrary, it has become more pronounced in response to needs considered increasingly essential and on which society's life has become more dependent. This attention is particularly evident in countries that are less well-endowed with fossil resources, such as France, an importer of coal and later of gas and oil, or countries in Eastern Europe, whose energy dependence on oil or gas-producing countries remains strong even today. Before shifting to address energy savings or concerns about decarbonizing the energy mix to contribute to the fight against climate change, it was primarily the need to ensure the security of the energy supply and continuity of service that was at the heart of users' concerns. It is within this context that Veolia's first expertise was developed ●

61 — BRAUDEL, Fernand. *The Identity of France: History and Environment*. London: Collins, 1988.

Heating Buildings and Populations: A Challenge of Modern Comfort

Today, so-called "energy performance contracts" are well-known, although not always adopted. Their purpose is to "improve the energy performance of a building through investments in renovations, supplies, or services." Such contracts are made between a company or a municipality and an energy service company. The service provider commits to specific energy consumption goals, which are measured and monitored over time. In reality, such contracts are not so new. In 1935, Léon Dewailly created Chauffage Service, a company specialized in the operation of heating and air conditioning systems. Two years later, on Christmas Eve, Léon Dewailly received a call from the director of the hospital in Villiers-Saint-Denis in Aisne. The coal-fired boiler was not working, and the cold was infiltrating the facility. "The on-site teams couldn't fix it," says Patrick Hasbroucq, director of industrial units in the Hauts-de-France region, "so Léon got in his car and drove to the hospital to fix the unit. The director was very satisfied with the repair and asked him to ensure the continued operation and maintenance of the equipment through a contract guaranteeing a defined temperature." This was the first-ever energy performance contract signed. It was a heating contract that would subsequently serve as a reference, known as "P1, P2, P3," covering nergy supply and operation; maintenance of installations; and equipment renewal. Supply security and service continuity were at the heart of the promise of this new company in tune with the times.

Léon Dewailly would make his business thrive, and it became the Compagnie Générale de Chauffe (CGC) after World War II. As a visionary entrepreneur, he innovated and relied on new multi-service contracts offered to certain clients, such as NATO bases. However, it was the boom in collective housing construction in France during the *Trente Glorieuses* (the post-WWII French economic boom) that allowed him to develop his business. At that time, heating became a new requirement for the comfort of a home, whereas in the past, a coal stove in the living room was often considered sufficient. From the harsh winter of 1954 onwards, Abbé Pierre's fight against substandard housing made domestic heating a major social issue. A gas heating boom followed: water heaters, boilers, stoves, and radiators all contributed to gas consumption in households. This growth began during the interwar period but gained momentum after World War II, while electricity still suffered from high tariffs and a lack of adequate infrastructure. As academic Jean-Pierre Williot writes, "Far from succumbing to electric competition, the gas industry claimed to be at the forefront of a movement promoting domestic comfort."[62] In 1946, 76 percent of gas consumption was due to domestic use, ahead of commercial and industrial use (8.7 percent).

Even though 60 percent of French homes still did not have central heating by the early 1960s, some major cities already had district heating networks before World War II (Paris in 1927, followed by Chambéry, Villeurbanne, Grenoble, and Strasbourg).[63] But it was the Trente Glorieuses that really brought about changes, in new construction first of all. Indeed, the construction of new residential areas often involved the installation of a district heating network, usually supplied by a power plant operating on oil or coal. To meet this demand, Chauffage Service transformed itself in 1960: it became the Compagnie Générale de Chauffe (CGC) and relied on its expertise to develop heating networks and energy performance activities through public service delegation contracts. Its motto was "Save fuel."

62 — WILLIOT, Jean-Pierre. *Du déclin au renouveau : l'énergie gazière en France au XX^e siècle*. Les Annales des Mines, 1998.

63 — Collective heating is the centralized production of heating for a building, as opposed to individual boilers in each apartment or electric radiators. Urban heating refers to the production and distribution of heating for an entire city or at least a neighborhood.

Léon Dewailly
THE HEATING ENGINEER

Leon Dewailly was born in Lille in 1895. This engineer by training became a heating operator and founded his own company, Chauffage Service, which invented the principle of energy performance contracts. Starting in 1937, Léon Dewailly signed the first energy performance contract in history with the Villiers-Saint-Denis hospital. This heating contract, known as "P1, P2, P3," covered energy supply, maintenance, and installation, as well as equipment renewal. Ensuring supply security and service continuity were at the core of this innovative company's promise.

However, it was only ten years later, at the end of World War II in 1944, that the engineer founded the Compagnie Générale de Chauffe (CGC). The company experienced rapid growth thanks to its multi-service contracts offered to the American bases of NATO, as well as to the booming collective housing and urban heating sector during the Trente Glorieuses.

Léon Dewailly also looked toward the international market and, in 1963, he established the Compagnie Générale de Chauffe Belge, followed by Associated Heat Services in Great Britain in 1966, launched through a partnership with the National Coal Board. The company took a decisive turn the following year when it sold 40 percent of its shares to Compagnie Générale des Eaux. Léon Dewailly retired from his position at the age of 86 in 1981. Ten years after his death in 1998, CGC became Dalkia, while still preserving the fundamentals inherited from its illustrious ancestor ●

Diversification of Heating Sources Accelerated by Oil Crises

As early as the 1960s, the very first incinerators capable of supplying heat networks through waste combustion were built, foreshadowing their transformation into "energy recovery units" (ERUs) in the 1980s and 1990s. Technically, some incinerators had already been able to recover energy for a long time: in 1907, the Issy-les-Moulineaux plant produced electricity using a turbo-alternator, and the Tours incinerator, built by the Société d'Entreprises pour l'Industrie et l'Agriculture (SEPIA) in the 1920s, produced both electricity and bricks made from the ashes. Inaugurated in 1968, the Villejean plant took things a step further by both producing electricity and heating a part of the Rennes metropolis—the first plant of its kind! The Société Bretonne d'Exploitation de Chauffage (SOBREC) was created in December 1964 to operate the urban heating network in North Rennes. It was a subsidiary of the Compagnie Générale de Chauffe, 40 percent of which was owned by the Compagnie Générale des Eaux from 1967 onwards.

Expanding the range of services it could provide to an area, the Compagnie Générale des Eaux fully integrated CGC into its group in 1980. It had already developed its own energy activities; in Rhône-Alpes, enterprising teams had established ECHM (Eau et Chaleur de Haute-Montagne) in 1963 to meet the water and energy supply needs of emerging Alpine ski resorts. Indeed, "the skills required to maintain

water and heat networks, even boiler rooms, were found to be similar, especially when considering the specifics of the mountain climate, from snow removal to coping with large temperature variations," says Bruno Godfroy, Deputy General Manager of the Water France business unit.

The first incinerators capable of supplying district heating networks with energy from waste combustion were built as early as the 1960s.

A few years later, in 1979, just before its full integration into CGE, Compagnie Générale de Chauffe produced a detailed report on its activities, demonstrating how the company had developed in response to energy crises caused by oil shocks. It had implemented various solutions such as geothermal heat, alternative fuels, heat from incinerators, heat pumps, and photovoltaic panels. CGC deployed these solutions throughout France and internationally, including in Belgium, Germany, Great Britain, Switzerland, the United States, and even hospitals in Saudi Arabia. It also considered developing energy from thermal power plant waste and photovoltaic panels, which were already being used to produce hot water for a holiday village in Martinique. Through a rudimentary remote monitoring system it had developed, precursor to the later Veolia Hubgrade centers, CGC's agents could remotely control temperature, consumption, and potential alarms across equipped networks in cities such as Rennes, Rungis, and Lille. The contracts signed in 1979 represented 46,300 kilowatts for heat production and 11,100 kilowatts for cooling, serving not only private individuals but also hospitals, the Post Office and Telecommunications administration, and hotel centers. As of the 1960s, CGC managed sixteen municipal waste treatment plants and in 1969 it installed its first geothermal system in the priority urbanization zone of the Almont department in Melun, which provided hot water for nearly three thousand residents. This was followed by installations at the Mont-de-Marsan air base, 826 housing units, a shopping center, a gendarmerie barracks, a nursery school, and a daycare center in Blagnac. During the 1980s, as a result of the oil crises, district heating networks gradually moved away from oil and turned massively toward natural gas or waste recovery energy.

Coal supply.

In the 1980s and 1990s, incineration plants increasingly shifted their focus toward energy production. According to Patrick Hasbroucq, incineration activity used to be primarily about the destruction of waste, but since the 1980s, incineration has represented only a small part of the installations, alongside smoke treatment and energy production in the form of heat and/or electricity. Attention is now focused on the environmental and energy performance of the plants. However, there is still considerable room for improvement in this area. Currently, only 62 percent of district heating networks in France are supplied by renewable and waste recovery energy. In 2021, a report from the Court of Auditors emphasized the importance of private operators in this activity and the benefits that individuals can derive from it. Due to the significant investments required to create a district heating network, the majority of public networks (80 percent) are operated through public service delegation. District heating and cooling networks

supplied by more than 50 percent renewable energy allow users to benefit from a reduced VAT (5.5 percent) on the energy supply portion of their bills. These strong incentives encourage further development and greening of these networks.

Performance: A French and Italian Heritage

In 1998, the Compagnie Générale des Eaux was renamed Vivendi. It then created a subsidiary called Dalkia, which brought together companies specializing in energy services, including the Compagnie Générale de Chauffe and other companies acquired by CGE over the years. Esys-Montenay also joined the venture, itself resulting from the merger of Montenay, a company founded in 1860 that initially focused on traditional heating, district heating, fuel trading, and air conditioning, and Esys, a holding company created by Elf in 1986 that brought together former coal trading companies. As a European leader in energy and environmental efficiency, Dalkia signed an agreement with EDF in 2000, with EDF acquiring a 34 percent stake in Dalkia and enriching it with its own energy service subsidiaries. This partnership ended in 2014 when EDF retained the brand and French activities, while Veolia took over the international activities.

It is within Dalkia that the culture of energy performance contracts would become even more important, following the historical path of the Compagnie Générale de Chauffe and an Italian company founded in Milan in 1927, which joined Dalkia in 2002: Siram (from the acronym for Società Italiana Riscaldamento Appalti Milano). Siram built its reputation on energy performance and supply security, managing boiler rooms for private individuals, businesses, and institutions for decades, as well as selling wood, coal, and oil. Its first historic contract was signed with the city of Venice in 1927, when the Compagnie Générale des Eaux—a long-standing association—operated the water service in Venice and supplied boats that transported wood and coal through the Venetian canals for boilers in schools, museums, and offices. Over the years, the company specialized in energy performance, building design, and maintenance of technical, thermal, and electrical systems. These strengths allowed Siram to secure the energy supply of crucial institutions such as the hospital in Parma, with which it has collaborated since 1951. As an example of its expertise, at that time, Siram managed only simple oil-fired boiler rooms in the hospital, but in the 1970s, it installed a large boiler, followed by a steam distribution plant in the 1980s. In the 2010s, it switched to natural gas, which is less polluting than oil, thanks to a type of underground thermal power plant known as "trigeneration." This cutting-edge technology allows for the production of high-temperature thermal energy for hot water and heating, low-temperature thermal energy for air conditioning or refrigeration, and mechanical energy capable of generating electricity. Today, with its 1,137 beds, 31 operating rooms, and 3,700 employees, the hospital produces 47 percent of its electricity needs and 100 percent of its thermal needs. In addition to these achievements, the building's carbon footprint has been reduced by 3,825 tons of CO_2 per year since the renovation work carried out by Siram.

In 2020, the Covid crisis highlighted the importance of securing the energy supply for strategic buildings such as hospitals. In Italy, in the hardest-hit regions, the Veolia group faced this emergency by ensuring the continuity of essential services at all costs while protecting its staff from risks. More than half of Siram Veolia's three thousand employees were deployed in Bergamo, Genoa, Parma, Bari, and Venice to operate seven hundred healthcare facilities, including over forty

The Covid crisis highlighted the importance of securing the energy supply for strategic buildings such as hospitals.

thousand hospital beds, and to urgently supply improvised intensive care units. During these challenging months, the staff secured essential services for the hospitals, including the management and maintenance of technological systems for energy production and distribution, air treatment systems, water quality control, and disposal of special hospital waste. Veolia's smart monitoring tool, called Hubgrade, proved particularly valuable during this period, allowing agents to remotely monitor the installations continuously. According to Francisco Silvério Marques, Director of Building Energy Services at Veolia, Hubgrade was developed to improve the energy performance of sites by using digital analysis capabilities to enhance the impact of the actions carried out by the teams operating the facilities. This dual local and remote involvement is part of the group's DNA and also helps address the primary goal of securing energy supply.

In Central and Eastern Europe, Expertise Developed to Meet the Challenge of Energy Sovereignty

Let's head east, about eight hundred kilometers from Italy, to Central and Eastern Europe. Since the fall of the Berlin Wall, the former countries of the Eastern Bloc have gradually embraced market economies. Today, these countries, known as Central and Eastern European countries (CEECs), including Bulgaria, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia, and the Czech Republic, have had to undergo profound changes in their understanding of public services. Over the course of the 1990s, the population had to adjust to the fact that previously free services now had to be paid for in order to increase their efficiency and reliability.

Mr Hubert Gamelin, Delivery Driver.

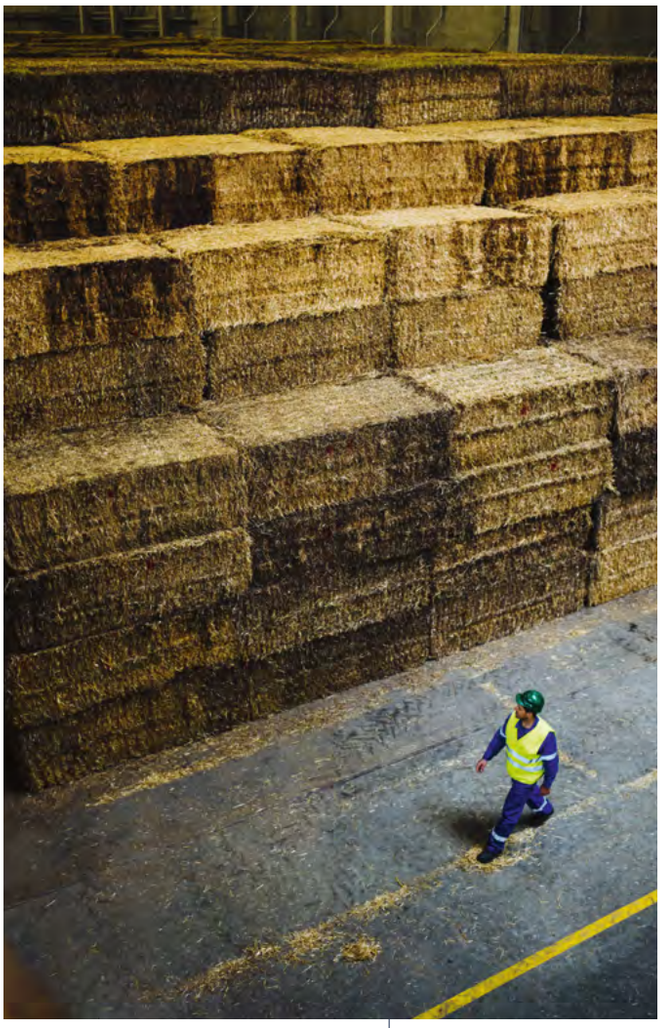
One of these services was energy supply. At the end of the twentieth century, the young democracies of Eastern Europe faced another colossal challenge: how to ensure energy sovereignty when almost everything had to be built from scratch? While strategies and public policies varied, one constant emerged: each state relied on local or foreign companies to lay the foundations for this desired independence and to apply for integration into the European Union.

During this period, Veolia accompanied these countries in reducing their dependence on Russian coal and gas and contributed to their improved energy autonomy. In 2022, the group supplied energy to twelve million inhabitants in the region. Veolia has gained the trust of many countries thanks to its industrial legitimacy as an energy producer and distributor. But it's not just about that. "We provide solutions that are sustainable. Our values are society, hygiene, safety, and transparency," says Philippe Guitard, Director of Central and Eastern Europe at Veolia. This trustworthiness has paid off; for example, Veolia's revenue in the Czech Republic reached 1.5 billion euros in 2022, even though the company had not yet established itself in the country in 1997.

Urban district heating networks are the primary activity through which Veolia has established a long-term presence in the CEECs. In cities such as Warsaw, Poznan, and Lodz in Poland, Bratislava in Slovakia, Budapest and Pécs in Hungary, and Prague and Ostrava in the Czech Republic, Veolia operates and modernizes thermal power plants. "In these countries, about 90 percent of medium and large cities are heated by collective district heating networks due to harsh winters. The current challenges are to secure heat supply and reduce the carbon footprint of the power plants," says Renaud Capris, CEO of Enova, former Director of Operations in the Czech Republic, Bulgaria, and Hungary.

Over time, the environmental performance of heat production units has been improved, as the standards of the 1990s were not strict enough. The CEECs' accession to the European Union in the early 2000s forced them to adopt the same rules as Western European countries, which required significant renovation work. "There is a proactive desire to gradually phase out coal-fired power plants. The city of Pécs in Hungary, with a population of about 200,000 inhabitants, has successfully converted its entire district heating network to biomass, completely eliminating coal and gas. Straw is collected from local farmers, as are wood residues," explains Renaud Capris. Most CEECs are in the process of transitioning to cleaner solutions such as biogas and biomass in order to move away from coal. "The goal is to offer alternatives at a reasonable cost for consumers," Renaud Capris adds.

Veolia has been present in this region of the world for over twenty years, where energy issues play a crucial role in political



The Pécs cogeneration plant in Hungary produces heat and energy from wood and straw.

and economic balances. This has become even more true since the beginning of the war in Ukraine in February 2022. One of the consequences of the Russian invasion is an increased awareness among the public of the significant dependence on Russia for energy supply, especially gas. Energy autonomy is no longer just an ambitious goal; it is now a regional security issue. The secure access to local energy has been at the heart of European regulatory developments since then, aiming to preserve resources by producing and distributing energy through the most efficient means possible. As a partner to local communities, Veolia designs and develops tailored solutions, allowing its clients to gradually overcome the uncertainties associated with market price fluctuations.

"The city of Pecs in Hungary has successfully converted its entire district heating network to biomass, completely eliminating coal and gas."

Renaud Capris

The story of energy intertwines with the turbulent history of a region at the center of important geostrategic issues. "Although reserves of oil, gas, and nuclear fuel remain, their sharp decline and the search for alternatives have led to a paradigm shift: the deployment of low-carbon technologies and energy efficiency are now matters of national and economic security," writes researcher Diana-Paula Gherasim on the website of the French Institute of International Relations (Ifri). She adds, "The risk of a carbon wall being erected in Europe between the West and the Central and Eastern European Member States is no longer relevant."

Energy sovereignty, decarbonization, and purchasing power converge fundamentally. While Central Europe still remains dependent on coal, there are numerous plausible opportunities to modify the energy mix. "Renewable energies are the cheapest source of electricity production for Poland, the Czech Republic, Romania, and Bulgaria,"[64] highlights a 2020 report by the Bloomberg NEF expert group. According to the authors of the study, a massive energy transition in the region would reduce CO_2 emissions from the electricity sector by 50 percent in ten years, making a 6 percent contribution to the European Union's emissions reduction targets.

For Francisco Silvério Marques, the future lies in energy savings and accelerated decarbonization. "In ten years, we will no longer be able to have energy service contracts based on fossil fuels. We will need to use on-site, decarbonized energy, local and renewable, which reduces environmental impact, promotes autonomy, and improves price visibility. Today, we are proficient in downstream operations, optimizing energy use, and we will continue to progress by guaranteeing even more energy savings. At the same time, we must continue to strengthen our upstream activities: our capacity to produce local and renewable energy to meet the needs of our clients." This vision of a decarbonized future could well materialize throughout the entire Old World and beyond ●

64 — BloombergNEF (2020). « *Investing in the Recovery and Transition of Europe's Coal Regions* ».

Story
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Saving Energy

From Oil Shocks to Digitized Services

The age of abundant energy based on fossil fuels relied on three structural elements: suppliers whose profits increased with the quantity of energy consumed, unlimited local usage thanks to resources imported from far away, and heavy, centralized infrastructure managing supply and distribution. The age of energy sobriety is a profound transformation of these three pillars, opening up new market opportunities based on the optimization of existing energy rather than extraction, maximizing local resources to reduce global impact, and creating decentralized networks organized around local consumers. While it is difficult to know exactly what this new world will look like, it will be profoundly different in terms of its actors, geography, and equipment •

GRÉGORY QUENET

If we look at the timeline of the history of energy from the beginning of humanity, we cannot say that the past two centuries have been characterized by energy savings. On the contrary, as noted by Patrick Criqui, a research director at CNRS (the Centre Nationale de Recherche Scientifique), "from 1900 to 1950, global energy consumption doubled, from one to two billion tons of oil equivalent (known as "toe"), then there was an acceleration and a six-fold increase between 1950 and 2010. It only took sixty years to go from two to twelve billion toe: just an instant on the scale of human history."[65] And it is not over. In the 2022 report of the International Energy Agency (IEA), the scenario based on current policies predicts that total energy demand will increase by 21 percent and electricity consumption will increase by 50 percent by 2040.[66]

Of course, these numbers hide very disparate local realities, as since the end of the twentieth century, it is mainly emerging countries that have been driving the growth in energy demand. Among developed countries, too, there are different models of energy consumption. The model of low-density, primary energy-producing territories like the United States, Canada, or Australia is characterized by high demand for transportation and energy-intensive household, automotive, and industrial equipment. On the other hand, European countries and Japan differ by having a higher population density and lower energy resources, resulting in a per capita consumption that is half as much as the previous model's. France is one of those countries whose history has been marked by more moderate energy consumption. In 1913, was only consuming a quarter of American needs, as Alain Beltran, a research director at CNRS, reminds us. During the first oil shock, for a base consumption of 100 in France, Americans were at 260, Great Britain at 120, and Japan at 86. Alain Beltran concludes, "Out of necessity, our country has never truly 'wasted' its energy."[67]

However, the main efforts of French policies have long focused on ensuring the security of the energy supply. The question is still far from resolved, as according to the IEA around 775 million people in the world still do not have access to electricity in 2023. But in order for the Net Zero emissions scenario to become a reality by 2050, as recommended by the IEA[68] and IPCC, it is imperative to go further in combining supply security with energy savings and the promotion of renewable energies. "Current high energy prices highlight the benefits of increasing energy efficiency," notes the International Energy Agency, "and encourage changes in behavior and technology in certain countries to reduce energy consumption. Measures to improve energy efficiency can have dramatic effects—today's light bulbs consume at least four times less energy than those sold twenty years ago—but there is still a lot to be done."

To amplify this effect, Eric Bardelli, Technical and Project Director of Veolia's Energy business in France, shares his belief in the importance of local public-private partnerships to meet the challenge of energy savings: "The key to success in embarking on the path of energy performance is to identify methodologies applicable to each region to save time and be more efficient. Veolia's expertise and know-how in energy issues allow us to take a broader view and develop a collaborative vision in which local elected officials play a decisive role." Energy sobriety and flexibility must therefore become predominant in the future, following the path laid out by the responses implemented after the oil shocks, whose good habits we have too quickly put aside ●

65 — CRIQUI, Patrick. "Global Energy Dynamics", in JEANDEL, Catherine and MOSSERI, Rémy. *L'Énergie à découvert*. Paris: CNRS Editions, 2013.

66 — International Energy Agency (2022). *"World Energy Outlook 2022"*.

67 — BELTRAN, Alain. *La politique énergétique de la France au XX^e siècle : une construction historique*. Les Annales des Mines: 1998.

68 — International Energy Agency (2022). "For the first time in decades, the number of people without access to electricity is set to increase in 2022".

From Oil Shocks to the Development of Energy Savings

In 2022, Western countries found themselves in a situation similar in many ways to that which they had faced with the oil shocks of the 1970s: their energy supply security was at risk. More than the growing awareness of environmental issues, this is what has rekindled political attention to energy savings. Veolia has been developing its expertise on this topic in the meantime.

When the French government announced an energy sobriety plan to cope with the rise in energy prices following the Russian invasion of Ukraine, those over sixty years of age clearly recognized that history was repeating itself. The government notably encouraged the French to not heat rooms beyond 19°C (66°F) and to connect to the EcoWatt application to avoid consumption peaks. Around a hundred companies also signed the EcoWatt charter with RTE, following Veolia's example, committing the group to replacing the most energy-consuming devices on the sites it operates, doubling its electrical load shedding capacity, and reducing temperature settings to 19°C (66°F) on its four thousand sites.

Similar measures had already been taken during the oil shocks of 1973 and 1979. In 1974, a law was passed to cap the legal temperature at 20°C (68°F), and then at 19°C (66°F) in a 1979 decree amending the law. These temperatures were even included in the Energy Code in 2015, but no control measures were truly implemented, neither at that time nor until today. Awareness campaigns continued until the early 1980s, promoting "weather-heating" to better "manage consumption."

Even at that time, sobriety was making its way into the language and companies were being called on to take action. As Pierre Amouyel, Head of Energy and Tertiary Activities at the General Commission for Planning, stated in the June 1980 issue of *La Jaune et la Rouge* magazine, "It is now essential that sobriety no longer be solely the result of 'good family' consumer behavior, but that it be materially integrated into the equipment, in the broadest sense, that they use in the houses or apartments they occupy; in the vehicles, individual or collective, that transport them; in the offices where they work; and in the factories that produce the goods they consume."

This period did not go without destabilizing heating companies, such as Compagnie Générale de Chauffe, which did not have permission to pass on the increase in oil prices to their consumers. However, it saw in the government measures a real opportunity for development, as it stated in a 1979 brochure: "Compagnie Générale de Chauffe can play a very active role in this new policy. Indeed, since its inception, its main goal has been to ensure energy control and develop its use under the most rational conditions."

The vision of that time resonated perfectly with that developed by Compagnie Générale de Chauffe from its origins: "To ensure the complete and sustainable management of installations, the group offers various types of contracts tailored to the needs of its customers. [...] These basic contracts, while ensuring users' appreciated comfort, meet the requirements of energy savings, equipment longevity, modernization, and renewal of thermal potential."

It was also an opportunity to better organize, under the leadership of Bernard Forterre, the Energy division of CGE and develop contract modalities that would become milestones, gradually standardizing and structuring the sector. In addition to the initial P1, P2, and P3 contracts (respectively: supply and energy management, equipment maintenance, and guarantee and renewal of equipment) that already underpinned the activity created by Léon Dewailly, the P4 on financing renovation work has been added.

Throughout the 1980s and 1990s, despite the oil counter-shocks[69] that would reduce political attention to energy and its economy,

69 — After the oil shocks of 1973 and 1979, the price of crude oil experienced a significant decline towards the mid-1980s, even returning to a level similar to that before 1973. In 1985, the term "oil counter-shock" was coined to describe this phenomenon.

the work begun would continue, leading to the creation of Dalkia in 1998 and, with it, the first DESCs (Dalkia Energy Savings Centers) which, from the headquarters, allowed the energy performance of its clients' buildings and installations to be monitored. This was an initial formalization of what would later be called Hubgrade and would become an essential element of Veolia's value, both for improving its service offerings and for managing its own processes. And it is in Belgium and especially in Dubai that this service would experience a real acceleration in its development.

Energy Savings, an Accelerating Activity in the Middle East

Paradoxically, it was in the United Arab Emirates that Hubgrade services would progress. This is paradoxical because one does not spontaneously imagine that it is in oil-rich countries, where energy is cheap and abundant, that offers to save energy would develop most rapidly. Yet, not all Emirates are alike—and Dubai has no oil. That is why, in the early 2000s, its princes invested in service activities, with the ambition to make their land a shining city at the heart of the United Arab Emirates' international influence.

Majid Al-Futtaim, who had created and managed an empire in utility services and had seen a Bedouin people transition from fishing for oysters and searching for pearls to a new civilization based on oil in just a few decades, was a visionary, convinced that commitment to sustainability would be a key element in his country's international acceptance. To achieve his ambitions, he partnered with Dalkia in 2002 in a joint venture, MAF-Dalkia, which would later become Enova.

"Veolia found a local partner who was committed and willing, which allowed the expertise to be developed and replicated in other geographic areas," says Anne Le Guennec, former CEO of Enova. "With MAF, we found a great partner who trusted us with their entire portfolio and with whom we advanced in co-construction. They opened up a playing field for us, and we worked on it together." This application field was considerable from the outset, from shopping centers, amusement parks, and hospitality

to residential areas. Then, driven by the joint venture's desire to make its activity profitable, it transitioned from operating only Majid Al-Futtaim's assets to offering building services on behalf of third parties.

Today, environmental reputation issues have materialized, and Enova is mobilizing its expertise in cost reduction in hospitals, airports, cinemas, hotels, and shopping centers in eight countries: the UAE, Oman, Bahrain, Qatar, Egypt, Lebanon, Saudi Arabia, and Turkey.

And there is no shortage of projects. "In the Middle East, reducing building cooling consumption is the main focus of our clients' energy savings," explains Renaud Capris, CEO of Enova, as temperatures sometimes exceed 50°C (122°F) in this part of the world. Lighting and a set of measures leading to a reduction in electricity consumption follow. To help its clients achieve their financial, operational, and environmental objectives, Enova has a technical department of around fifty engineers specializing in energy audits. "We spend several weeks on the building to analyze its weaknesses and make technical recommendations," explains Renaud Capris. The idea is to install the right solutions in the right place to minimize the building's energy consumption. To save energy, the group offers "retrofitting" solutions (upgrading aging equipment), optimization of air conditioning, and on-site maintenance at all levels of the chain thanks to its specialized engineers. "We are the only ones who ensure the maintenance of energy installations by guaranteeing a specific percentage of savings," adds Capris.

Hubgrade has become a smart monitoring tool that optimizes installations and preserves resources in terms of energy, water, and raw materials.

Hubgrade has become a smart monitoring tool that optimizes installations and preserves resources in terms of energy, water, and raw materials. Capris says, "In a shopping center, we collect a certain amount of data, such as electricity consumption, room temperature, air quality, and any information that has an impact on the building's energy consumption. Our data analysts can then monitor this consumption in real time thanks to an extremely efficient algorithm and know what action needs to be taken." As true performance control centers, Hubgrade centers combine human and digital expertise. "When a deviation is identified by a Hubgrade center," explains Francisco Silvério Marques, "our on-site operators intervene immediately—for example, to replace a filter, lubricate moving parts, or check the tightness of a regulating valve. These are often invisible elements but have a significant impact on energy consumption."

This expertise in energy savings has also continued to develop through Siram in Italy, which ensures the energy efficiency of numerous hospitals and public buildings beyond questions of energy supply, including the Monaldi Hospital in Naples and the campus of the University of Parma. While the core of the university's energy renovation project involves the construction of a new trigeneration plant and a geothermal plant to supply 50 percent of the university's energy needs with green energy, digital technologies were also used to control and monitor energy flows in real time. This solution made it possible to implement specific predictive diagnostic functions as well as use innovative algorithms capable of reducing primary energy consumption by 20 percent—the objective set by Siram for each project in Italy.

In 2020, inspired by these examples, Veolia had sixty-four Hubgrade control centers in over twenty-two countries. While each center has its own characteristics, they are now converging toward a common ecosystem in order to benefit from the most efficient innovations in energy savings. A Hubgrade Academy has also been established to provide training worldwide for Hubgrade analysts, covering all the knowledge necessary for their profession: contractual models, roles and responsibilities, Veolia's energy performance analysis strategy, and means of communication for different stakeholders.

The interest in deploying these global services in local communities and businesses has become evident: building energy consumption accounts for 35 to 40 percent of global CO_2 emissions, and in Europe alone, the European Commission estimates that three out of four buildings are energy inefficient. Christophe Schuermans, Director of Building Energy Services Development at Veolia, explains that "the analysis and energy audit of a building lead to a large number of actions, such as adapting equipment operation based on actual occupancy: renewing air in a meeting room based on the number of

Hubgrade: Digital Tools for Energy Savings

Despite the development of renewable energies, the fight against climate change cannot escape energy sobriety. To address the ecological and economic challenges of the twenty-first century, digital tools have been developed and deployed by Veolia for over a decade. These tools serve the optimization of energy consumption, as well as the better management of water and waste services.

Could the future of energy efficiency lie in tracking? This is what Hubgrade suggests. This remote management center combines artificial intelligence and human intelligence to optimize the energy performance of buildings and urban infrastructure. Through connected objects and cutting-edge technologies, data from water networks, energy services, and waste collection are sent in real time to the platform to be analyzed by professionals.

By relying on field agents equipped with digital tools, remote data analyst teams, and system engineers, the service offered by Hubgrade is built around three major pillars. The first pillar, "connect," creates a connection with clients by providing them with real-time information. It goes hand in hand with the second pillar, "support," which assists them in their operational issues, and ultimately, with "improve," which helps them optimize the operational and environmental efficiency of equipment and infrastructure.

Hubgrade control center in Aubervilliers (France).

From Bilbao to Dubai, Sixty-Four Control Centers

From Bilbao, Spain, to Sydney, Australia, passing through Dubai and Shanghai, Veolia had sixty-four Hubgrade control centers worldwide in 2020, in over twenty-two countries. Through these centers, Veolia supports shopping centers, hospitals, schools, and office buildings to move toward a future that is less energy-intensive, as well as less water-intensive and less waste-producing.

In Dubai, Enova, Veolia's subsidiary for the Middle East, has been assisting the Mall of the Emirates shopping center in the operation and maintenance of its cooling and heating system since its opening in 2005. In Bilbao, the Hubgrade center manages two thousand installations, one thousand buildings, sixty industrial sites, and twenty cooling and heating networks. In France, the management of water and waste in the city is monitored and analyzed in the Lille center.

Hubgrade leads to improved profitability as activities are measured and examined in real time, enabling immediate action by technical teams in case of issues. In terms of energy bills, Veolia allows its clients, through these "hypervision" centers, to achieve an average savings of 15 percent. In 2020, this represented 35,500 MWh of heating and cooling and 77,000 MWh of electricity saved

people present, slowing down or stopping escalators depending on the crowd, lowering temperatures in unoccupied areas, using motion sensors to activate lighting, etc. These actions, combined with operational monitoring by energy analysts in our Hubgrade centers, allow for significant savings of over 10 percent with a low investment."

Building energy consumption accounts for 35 to 40 percent of global CO_2 emission.

However, efforts must be accompanied by education for the public and staff. With the Awareness service, Veolia offers a communication approach aimed at raising awareness among building users about the environmental impact of their behavior, as was the case with seventy-four schools in Košice, Slovakia, where Veolia installed seventeen thousand thermostats and replaced old boilers while implementing an energy-saving campaign among the students. The same approach was taken in Brussels, where the 1,700 employees of the National Pensions Office (ONP) were sensitized to energy sobriety through conferences, progress indicators on smartphones, and stickers and posters describing good practices to adopt.

In doing so, Veolia has become a reference company in terms of energy performance, combining its offers with an operational performance approach for its own services: the ReSource plan, launched in 2022, aims to increase the company's energy production, reduce its consumption, and make it more flexible.

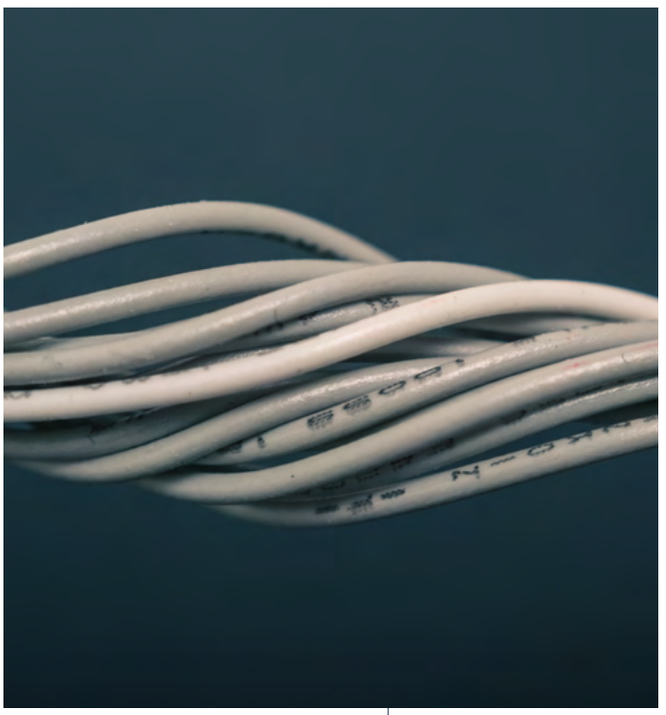
Is Energy Flexibility a Major Challenge for the Decades to Come?

Many observers believe that today the question of energy management, i.e., how much energy we consume, is no less important than when we consume it. The issue gained national importance in France with the implementation of the EcoWatt system during the winter of 2022–2023, a kind of "electricity forecast" that aimed to inform users in real time about consumption on the electricity grid in order to avoid consumption peaks that could lead to a network failure. Launched by the French electricity network operator RTE, in partnership with the Agency for the Environment and Energy Management (Ademe), EcoWatt was born out of specific problems related to the simultaneous increase in energy consumption in winter and the decrease in French nuclear production. These conditions could easily be repeated in the coming years, since renewable energies such as wind and solar power, which are expected to play an increasing role in our energy supply, have the particular characteristic of facing significant production variations. A nuclear power plant itself tends to become intermittent, even if only marginally, but the variation is more controllable in this case. In summary, the volatility of electricity prices and availability requires us to rethink our approach to energy consumption.

Some French people are already familiar with the concept of energy flexibility, as around thirteen million of them benefit from off-peak tariffs and therefore heat their water heaters at night to use the water the next morning. On the scale of a tertiary building, this comes down to encouraging similar good practices, such as programming the charging of electric vehicles during low consumption periods, operating equipment alternately, and starting heating earlier in the morning. These habits need to be automated through smart grid systems—intelligent electricity networks. This is where Veolia's Hubgrade solution, for example, comes in, capable of analyzing personnel usage and anticipating consumption peaks, as well as alerting users to malfunctions and controlling building flows such as heating, hot water, ventilation, and air conditioning. Not to mention energy production, as many buildings are now equipped with this capacity through photovoltaic panels or geothermal energy. The building then becomes a full-fledged player in the electrical grid.

To achieve this flexibility, it is not only necessary to change the energy

paradigm in people's minds but also to be accompanied by experts in the field, whose expertise ranges from anticipation and certification to ensuring network stability. This is the case for Flexcity, a Franco-Belgian startup created in 2012 under the name Actility that was acquired by Veolia in 2019. For Flexcity, the new energy situation should push industrial and tertiary groups to think not only as energy consumers but also as energy brokers. "We help companies thrive in a world with high electricity volatility, consume and produce energy at the right time, and pay attention to the overall balance of the network," explains Arnout Aertgeerts, Chief Executive Officer at Flexcity. By aligning demand and production, companies like Flexcity hope to correct negative energy prices in the wholesale market, which are a signal that non-flexible production is significant while demand is low. In such cases, some will have to pay to produce energy, and conversely, others will be paid to consume it.



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In the context of electrical flexibility, some will be remunerated for "disappearing," that is, shifting their consumption when necessary for the network. For example, Flexcity supported the steel company Thy-Marcinelle in its efforts to save energy and reduce its CO_2 emissions. This industrial company can modulate the overall consumption of its site, reducing it temporarily by mainly reducing the consumption of its electric arc furnace and rolling mill, in order to relieve the Belgian electricity network. These occasional consumption reduction activations adapt to the technical constraints of the site thanks to Flexcity's equipment, which evaluates these power modulations based on rigorous data analysis. Through its expertise, Flexcity determines the volumes and availability times, as well as the conditions of its offerings on the market. Thy-Marcinelle also receives compensation for reducing its electricity consumption while operating a service in line with its process improvement requirements. Veolia itself also contributes to this balance. "We have implemented this approach on the sites we operate," says Gad Pinto, Director of Local Energy Loops activity at Veolia. "Indeed, for water treatment plants, we can ask them to reduce or shift their electricity consumption without changing the treatment process. Dedicated offers for the water sector have been developed to meet the specific needs of each type of site: drinking water production, pumping stations, wastewater treatment plants, etc." By installing a control box or developing communication interfaces with existing remote management systems, Flexcity is able to send activation signals for demand response capacities during periods of tension reported by RTE, for example. Upon receiving this signal, participating sites have between a few minutes and several hours to reduce their consumption by stopping or slowing down certain treatment processes for one to two hours.

The volatility of electricity prices and availability requires us to rethink our approach to energy consumption.

Overall, in 2022, Flexcity enabled the flexibility equivalent of one nuclear unit in Europe. In theory, the applications of this flexibility could be deployed across even larger domains thanks to electricity storage, which is currently expensive but could benefit from innovations in the coming years. For example, the European NGO Transport & Environment estimates that the number of electric vehicles in

circulation in Europe will be between thirteen and fourteen million in 2025 and between thirty-three and forty-four million in 2030. And since the storage capacity of these vehicles will be several thousand gigawatts, it is not a stretch to imagine that these batteries could stabilize the electrical grid by injecting electricity into the system during consumption peaks.

In its preparatory report “Understanding and Managing Electrification by 2035,” presented in June 2023, RTE predicted a significant increase in electricity consumption in France, reaching between 580 and 640 terawatt-hours by 2035, as a result of decarbonizing our energy mix. “This rate has not been reached since the 1980s,” says the network operator, “and highlights the magnitude of the challenge the French electricity system faces if it wants to meet new ambitions and the latest overall parameters.” To meet this growth, RTE relies on energy efficiency, sobriety, renewables, and nuclear power. Of course, the report also predicts greater variability in electricity production, which necessarily requires flexibility measures. “In this context, the role of storage solutions and demand flexibility solutions will become increasingly crucial,” the report continues.[70] These analyses are very similar to those of the International Energy Agency, which states that “power plants will need to be more responsive, consumers more connected and flexible, and network infrastructure reinforced and brought up to date with digital technology.” These are challenges that Veolia is increasingly prepared to meet..

However, this massive electrification of our energy uses must be accompanied by its indispensable counterpart in the fight against climate change: the decarbonization of our energy. This project must give prominence to local regions, which are the only ones capable of resiliently producing local renewable energy from biomass, geothermal energy, solar power, wind power, waste heat recovery, or wastewater. These are all local solutions to the global problem of our planet’s warming ●

70 — RTE (2023). "To understand and manage electrification by 2035."

Story
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Decarbonizing Energy

Local Solutions for a Global Problem

The terms used in the energy debate are often misleading. They are, in fact, produced by the players themselves in a sector that is both highly material, marked by constraints and inertia, and highly speculative, involving visions of the future. As historian Jean-Baptiste Fressoz has shown, the notion of energy transition, popularized in the 1970s, masks the way in which a new energy source is added to existing ones instead of replacing them. This is the real challenge for renewable energy: is it once again about providing an additional energy supply through the use of a new source alongside existing ones or about reducing the extraction of fossil fuels? The victory of coal over wood in the 1860s relied—long before energy efficiency, which came much later—on a conceptual tour de force invented by English economists: defining materials manufactured by natural processes that have taken millions of years as "stocks," a kind of underground department store to be discovered. Rather than using the term "renewable," which could establish an eco-modernism reactivating the ideal of limitless energy, the future tour de force would be to consider all energy to be limited, which is the case for the total quantity of energy on Earth, and thus to prioritize circularity over addition ●

GRÉGORY QUENET

The sixth report by the Intergovernmental Panel on Climate Change (IPCC), released in March 2023, confirms that the Earth's temperature continues to rise, reaching its highest level in the past 125,000 years during the 2011–2020 decade. Scientific experts estimate that by 2030, the planet will have warmed by 1.5°C compared to pre-industrial times, regardless of immediate efforts to reduce global CO_2 emissions. We are already living in the era of climate change and its consequences.

In order to preserve the future of life on Earth, the IPCC outlines a path to cap emissions growth in the short term and reduce emissions in the long term, with the goal of achieving carbon neutrality by 2050. Energy, whose consumption has been exponential since 1850, has a crucial role to play. While it is predominantly fossil-based today and releases billions of tons of carbon that had been sequestered over millions of years on Earth, the group of scientists estimates that up to 77 percent of global energy needs could be met by biomass, solar, wind, hydroelectricity, geothermal, and marine energy, alongside the necessary energy savings. This massive shift to clean energy sources represents the greatest potential for short-term reduction in greenhouse gas emissions by 2030. Modifying the energy system is possible: the declining costs of renewable energies and green technologies observed in recent years, from solar to wind, can facilitate the energy transition, much like the shift from wood to coal accelerated the system's use in the mid-nineteenth century. However, unlike what happened then, this is still subject to strong political will, especially given the urgency of the situation.

The decarbonization of the energy mix has indeed begun to permeate public policies. The European Union goes so far as to make it an element of leadership: the Council of the European Union launched a step-by-step adoption process in 2021 for the so-called "Fit for 55" package, which includes thirteen legislative proposals defining the objective of reducing net greenhouse gas emissions by at least 55 percent by 2030 compared to 1990. Among these proposals, the promotion of renewable energies is central, also on the agenda of the REPowerEU plan in 2022, alongside the strengthening of natural carbon sinks, the end of sales of internal combustion engine cars by 2035, the reduction of energy bills for buildings, and the overhaul of energy taxation.

On the ground, things are changing. Germany is one of the first countries to have clearly shifted its energy policy: while renewable energies represented 6.89 percent of its electricity production in 2000, they now provide 49 percent of German electricity in 2022. Other countries such as the United Kingdom, the United States, and China have caught up in a matter of years. By introducing a carbon tax in 2013 and launching low-carbon electricity production support programs in 2014, England has succeeded in making renewable energy the country's primary source of electricity in 2020. For the first time in the first five months of 2023, solar and wind power in the United States have surpassed coal in electricity production. Thanks to subsidies, but also to more flexible legislation in certain states, states such as Texas, a solar energy champion, and California, which aims for 100 percent renewable electricity by 2045, stand out. In China, the capacity for wind and solar energy production has increased tenfold since 2010, and the country holds a large share of industrial production of photovoltaic panels (63 percent of cells, for example) and wind turbines (over 40 percent).

Even in France, the situation is changing. Because "France has not been a promoter of renewable energy, it is lagging behind compared to all European countries," says Jacques Vernier, director of the Agency for Ecological Transition (Ademe) from 1994 to 1997. The prevalence of nuclear power has reduced our fossil energy consumption, but it has

also slowed down renewable energy development, and France is still behind on its objectives. However, the development is nevertheless exponential: "In 1996, when I wrote the *Que-sais je?* book, I noted that there were only three wind turbines in France, in the Aude region," remembers Jacques Vernier. "In 2023, there were 8,000."

However, the global equation is not yet solved: fossil energy consumption continues to increase. According to the International Energy Agency, global natural gas demand could increase by 28 percent and oil demand by 17 percent by 2050. That is why many experts, like historian Jean-Baptiste Fressoz, reject the term "energy transition" in favor of "energy stacking," with each new energy source being added to the mix of each country over the course of its history.

How can we avoid this scenario and fundamentally reverse the trend? Some regions are beginning to outline an "energy unstacking," similar to what is happening in Europe and even North America, which is reaching a plateau. With the solutions it has developed and the innovations it is working on, the Veolia group can amplify this movement. This is the objective that Estelle Brachlianoff placed at the heart of the ReSource plan in 2022: to reduce energy consumption and increase the group's green energy production ●

Using Recovery Energies to Move Away from Fossil Fuels at the Local Level

Veolia has developed solutions to enable territories and industries to move away from coal and other highly carbon-intensive energies, at the intersection of two long-standing expertise areas: energy recovery from waste and the operation of district heating networks, which connect production sources to consumption sites.

As early as the late 1960s, the Compagnie Générale de Chauffe (CGC) operated an incineration plant supplying heating to certain neighborhoods in the city of Rennes. Since the 1980s and in response to the oil shocks, new French incineration plants—now called "energy recovery units" or ERUs—have been equipped to recover heat from waste, while older plants have gradually been updated. The proximity of the ArcelorMittal plant near Nantes even contributed to the location of the Arc-en-Ciel waste recovery plant in Couëron, operated by Veolia since 1993.

The group's expansion into Eastern Europe in the early 2000s has accelerated the development of its expertise in the operation of district heating networks and their greening. One of the first examples is the district heating network in the city of Pécs, Hungary, established in 2005: the homes of the city's 200,000 inhabitants are now almost entirely heated through the urban network, which no longer uses coal or gas, both of which are major CO_2 emitters, but only biogas. Some of this biogas is obtained from straw collected by local farmers and from recovered wood residues. Combined heat and power generation techniques, and even trigeneration—

the production of electricity, heat, and cooling from the same source—have since proliferated everywhere.

This combined expertise is now contributing to the decarbonization of cities where it can be replicated. This is the case for the European metropolis of Lille, where, thanks to the recovery of waste as electricity and heat, the last coal-fired power plant in northern France was closed in 2021, thirty years after the closure of the last mine in the region. “In France, there is no other network equivalent to the one in Lille,” explains Patrick Hasbroucq, director of industrial units at Veolia. “It is even the longest in Europe, with a twenty-kilometer connection between the plant and the city.” In terms of energy, the plant ensures the recovery of all municipal waste in the Lille metropolis, delivering 270 gigawatt-hours of heat per year, equivalent to the consumption of thirty-five thousand homes, and 91 gigawatt-hours of electricity, sufficient to meet the demand of twenty thousand households. Economically, the project has demonstrated its viability: the forty-million-euro investment by the metropolis will be offset over time by energy revenues, and for subscribers, the energy price is particularly competitive due to a reduced VAT rate of 5.5 percent on the variable portion of the bill. Most importantly, this new infrastructure is also beneficial for the environment: coal dust emissions have been significantly reduced, and fifty thousand tons of CO_2 are avoided each year, equivalent to fifty million round trips between Paris and Lille by high-speed train.

It also contributes to the decarbonization of industries, such as in Lorraine, where Solvay has been producing soda ash, an industrial by-product with multiple uses from the manufacture of glass to toothpaste, for over a hundred years. The chemical manufacturer has partnered with Veolia to replace three coal-fired boilers with a boiler equipped with two furnaces that operate on solid recovered fuels (SRF), waste that cannot be recycled. As carbon quotas are gradually applied to European industry,

The Halluin Energy Recovery Center (Lille Metropolis). This site converts non-recyclable household waste into electricity through their combustion.

this will support the site's competitiveness and maintain employment by reducing the carbon footprint of industrial activity by half and eliminating the annual importation of 200,000 tons of coal.

The development of district heating and cooling networks today aims to maximize the use of every bit of energy by sharing energy from decentralized production locations. In 2023, Veolia was entrusted with the operation of the Paris-Saclay network, a unique installation in Europe combining deep geothermal energy and the recovery of waste heat from the CNRS supercomputer and the cooling network. The system aims to double the delivery of heat and cooling to support the urban campus's real estate development.

Recovered energy is at the heart of a paradigm shift both from an ecological and energy sovereignty perspective.

Recovered energy is at the heart of a paradigm shift with immense potential both from an ecological and energy sovereignty perspective. "In the past, we operated in a mode where we produced energy when we needed it," says Gad Pinto, director of local energy loop activities at Veolia. "However, when we produce energy in this way, a lot of energy is wasted. For a long time, this didn't bother anyone: why bother recovering it when the primary energy source is virtually free? Today, that is no longer the case: we seek to recover heat from data centers, wastewater, industrial processes in the steel, chemical, cement, and agri-food sectors, etc. Furthermore, when relying on the national gas or electricity grid, if it is cut off from certain supplies such as Russian gas, a company or community finds itself in a vulnerable situation. The development of local solutions helps address this. Scaling up to all territories requires the capacity to integrate different expertise, which is gradually happening, as measured by Annaïg Pesret-Bougaran, director of the Arc-en-Ciel plant: "In 1993, our plant was a completely innovative project, to the point that three subsidiaries of the group formed a partnership to respond to the call for tenders, with each bringing their expertise in incineration, waste sorting, and district heating. Today, everything is more integrated thanks to our experience." The novel technology is gradually being industrialized to have a greater impact.

Maximizing Impact by Mobilizing All Resources

By energetically recovering non-recyclable waste from incineration plants or landfill sites, Veolia ensures the best possible use of the resources entrusted to it. The same logic is applied by the group in the valorization of wastewater and the sludge extracted from it, in installations that cover tightly-knit territories.

Wastewater treatment plants are thus the preferred sites for the deployment of anaerobic digestion, which transforms organic matter into energy. "The two historical sectors that have developed anaerobic digestion," explains Julien Thual, anaerobic digestion engineer for Ademe, "are the agri-food industry and urban wastewater treatment plants, for the purpose of treating their sludge and recovering biogas as heat. These activities were carried out in cogeneration, producing electricity and recovered heat, which were valorized around the anaerobic digestion plant." Indeed, wastewater treatment plants produce large quantities of sludge during their treatment process, which can be reduced in volume and organic load. How? By transforming them into energy.

According to Alain Le Divenach, head of Structuring Projects for the Mediterranean region at Veolia, "a hundred years ago, the group's first drinking water plants in Nice and Toulon were already producing their own electricity using a turbine. Since the electricity grid was less developed than today, our predecessors had the motive to produce a part of their energy with water. And then it was abandoned for economic reasons. Digestion (the process that allows for a significant reduction in the volume of sludge produced), the stabilization, and the generation of biogas were also used in the past, and then for a while, we switched to very large basins with very long stabilization times, which are energy-intensive. In recent years, we have renewed our interest in

When Water Waste Becomes Energy: Sewage Sludge

Sewage sludge is the main waste produced by a wastewater treatment plant from the various liquid effluents it processes. It consists of organic and mineral matter and can be categorized into three types. Primary sludge, which results from the settling of effluents and has a high mineral content; physico-chemical sludge, which is similar to primary sludge but contains flocculating agents; and biological sludge or activated sludge, which is produced through bacterial treatment.

"With the boom in wastewater treatment plants, the volume of sludge has significantly increased," says Paul-Antoine Sebbe, CEO of SEDE, a Veolia subsidiary specializing in sludge treatment and valorization. Similar to wastewater, the major challenge therefore is to no longer consider sludge as waste, but as a resource to be valorized. So what can be done with this sludge?

Pierre Forgereau, Director of the Artois Douaisis region at Veolia, explains the three main ways to valorize industrial and urban sludge. Firstly, while ensuring sanitary quality, "these sludges can be used for agricultural land spreading.

Methanizer.

This has an agronomic impact, as they increase the fertilizing value of the soil," he explains. Currently, 75 percent of sewage sludge is spread on agricultural land.

Sludge can also be composted with other green waste to create agricultural inputs and provide fields with richer organic matter.

"The third valorization option is to convert it into biogas. This is something that has existed for a long time but is now being revisited due to the energy crisis. More and more municipalities, such as those in Angers or Hénin-Beaumont, are investing in biogas production," highlights Forgereau

digestion, which is making a comeback in our plants. We are also interested in significant pressure variations between reservoirs. Generally, to avoid a sudden influx of water with a high jet, pressure reducers are installed. Increasingly, we are replacing the reducer with a turbine: with it, there is no mechanical dispersion, and we produce electricity."

Today, energy production ensures the continuous operation of facilities and supplies the surrounding areas in need. Philippe Guitard, director of the Central and Eastern Europe zone at Veolia, explains their expertise in energy recovery through a digester that processes various waste materials, such as expired yogurt, to generate green electricity that can be sold to cities like Bucharest or Budapest. In Sofia, Bulgaria, Veolia manages the first positive energy wastewater treatment plant in Europe, which has produced 23 percent more energy than it consumes and sells the surplus electricity to the public grid operator. In Braunschweig, Germany, Veolia has made the wastewater treatment plant self-sufficient. Similarly, in Cagnes-sur-Mer, France, the first positive energy wastewater treatment plant was launched in 2021. By valorizing the available heat and energy at each stage, this French plant produces 10.5 gigawatt-hours of biomethane per year, exceeding its consumption of 8.7 gigawatt-hours and injecting the surplus biomethane into the GRDF network. In Fréjus, the valorization of sludge from the wastewater treatment plant also provides green fuel for public transport, with the biomethane produced equivalent to the consumption of over 40 percent of the city's public bus transport network. Julien Thual, from Ademe, concludes that methanization is one of the most virtuous forms of energy, as it offers multiple benefits, including the substitution of mineral fertilizers with organic fertilizers, continuous energy production throughout the year, and local resilience.

In Sofia, Veolia manages the first positive energy wastewater treatment plant in Europe, which has produced 23 percent more energy than it consumes and sells the surplus electricity to the public grid operator.

Solar energy also plays a role in Veolia's decarbonization efforts. Particularly in seawater desalination activities, where Veolia is a global leader, solar energy is being utilized to reduce the environmental impact. Advanced reverse osmosis technologies have already reduced the energy required for seawater desalination by approximately 80 percent since the 1980s. Now, with the industrial deployment of solar energy, Veolia aims to go even further. Renaud Capris, director of Enova, explains the shift from high carbon footprint desalination solutions to a mix of solar and electrical energy, with future plans to use only solar and hydrogen to power the plants. For example, the Sharqiyah Desalination plant in Sur, Oman, has installed thirty-two thousand high-efficiency solar panels equipped with an east-west tracking system to optimize energy production based on the sun's orientation. This installation will generate over thirty gigawatt-hours of green electricity per year, meeting more than one-third of the daily consumption of the desalination plant, which provides water to 600,000 people.

On the other hand, Veolia is utilizing smaller areas of land for solar energy production, especially in post-exploitation waste storage sites. For instance, on the former Tougas landfill near Nantes, Veolia installed photovoltaic panels on ten hectares of land in 2019. These panels produce eight gigawatt-hours of electricity per year, supplying power to over a thousand households. Veolia aims to make its services energy self-sufficient throughout France by combining various solutions such as waste valorization, methanization, biofuel production, and photovoltaic energy development on its sites. Jean-Christophe Taret, director of ecological transformation for the France and special waste Europe zones at Veolia, emphasizes the importance of resource valorization in decarbonizing the group's activities and highlights the need for both extensive and intensive approaches. Extensive approaches involve generalizing techniques across all installations, such as biogas capture worldwide. Intensive approaches focus on isolating and maximizing the value of each resource stream, such as specifically collecting biowaste in France.

Supporting the Transition of Energy Sources and Making Green Energy Greener

Veolia's mission for the coming years is not only to optimize the value of each resource stream but also to support the transition to renewable energies and make green energies even more circular and resource-efficient.

Nuclear Energy, a Transition Energy to Be Secured

In France, Japan, and the United States, Veolia Nuclear Solutions (VNS) is involved in activities related to hazardous waste treatment and decontamination applied to nuclear energy. Jean-François Nogrette, director of the France and special waste Europe area, explains the origins of this subsidiary, step by step, as the group assumes the practice: "In France, the Atomic Energy Commission (CEA) uses a cold solidification technique called vitrification for radioactive waste, which was initially licensed by Veolia, created from its hazardous waste activity. Following this experience, we took our first steps in the nuclear sector before deciding to pool resources to establish a specialized activity and reduce costs. Since then, we have acquired a business in the dismantling and treatment of radioactive waste, and we have opened a radioactive waste treatment facility in Texas with a treatment process that follows the same logic as that of hazardous waste, in which we are one of the world leaders with SARP Industries." With technologies such as Geomelt, which allows the vitrification previously reserved for highly radioactive waste to be applied to low-level radioactive waste, Veolia now enables the reduction of nuclear waste volumes in collaboration with partners like EDF, addressing the core issue of the acceptability of this energy source.

The tsunami that struck the Fukushima nuclear power plant in Japan in 2011 was another opportunity for Veolia's teams to demonstrate their nuclear expertise, combining short-term and long-term solutions. Immediately after the disaster, the company's engineers developed a water cooling system (ISMS) capable of safely treating the cesium-contaminated water in the plant (cesium being a highly radioactive element). Over the following decade, Veolia developed new technologies, particularly in robotics, for the dismantling of the site. Remotely operated robots capable of inspecting and repairing the damaged containment vessel and working in the extremely hot and radioactive reactor core were developed. The Boom robot, for instance, was designed to unfold an arm composed of different segments in an extreme environment. Dominique Richit, former CEO of VNS, explains: "Radiation burns chips in record time, so we opted for remote electronic control in a protective casing. The arm itself contains very few electronics. Measurements are transmitted by electrical signals from the robot's end to the control room."[71]

To make green energy even more circular and resource-efficient: that is a mission for the years to come.

Optimizing the Lifecycle of Each Energy Source

In addition to securing nuclear energy production and optimizing its environmental impact to ensure greater acceptability, Veolia adapts to the choices made by local or national communities to apply the same logic to each type of energy adopted. In Japan, for example, after the Fukushima nuclear disaster, the country shifted its energy strategy towards renewable energies, aiming to reduce nuclear energy from over 30 percent to less than 20 percent. In line with this diversification strategy, Veolia collaborates with local industrial player Takeei to rehabilitate forest resources for biomass electricity production in Japan. Veolia currently manages several biomass plants in Japan, ensuring the highest level of energy efficiency from this resource.

Wind energy, a widely promoted renewable energy source worldwide, must demonstrate its positive impact to gain support from the public. The recycling of wind turbine blades is one key issue that needs to be addressed. While the carbon footprint of wind turbines is good, their blades, made mostly of composite materials

71 — RICHIT, Dominique (statements collected by MANN, Nathan) "Comment Veolia conçoit un robot de 21 mètres pour le démantèlement de Fukushima". *L'Usine Nouvelle*, March 22, 2021.

Biomass plant in Hirakawa, Japan.

such as fiberglass, are difficult to recycle. Many first-generation wind turbines are reaching the end of their lifespan (which averages twenty years), and the University of Cambridge estimates that there will be forty-three million tons of used blades by 2050. Without proper treatment, these blades could end up in landfills.

Veolia is working on finding ways to give these blades a second life by using them in cement production. In 2020, the company reached a milestone with GE Renewable Energy. The goal was to recycle these blades during the revamping or repowering of GE's onshore wind farms in the United States. The recycling process begins on-site at wind farms, where the blades are removed and transported to a facility where powerful machines shred them into smaller pieces. These pieces are then transported to a Veolia plant, where they undergo further grinding to reach the size of gravel. Through this process, over 90 percent of the blade's weight is valorized: 65 percent as a raw material, replacing sand, clay, and other materials, and 28 percent as an alternative fuel, replacing coal to provide energy for the chemical reaction in cement kilns. This unique contract in the American wind industry aims to valorize thousands of wind turbine blades in the coming years.

The electrification of energy production also highlights the importance of battery recycling. Battery production is highly carbon-intensive, and the rare metals they contain are at the center of sovereignty concerns. By 2035, when the ban on the sale of combustion engine vehicles will have just come into effect in the European Union, around seven million tons of batteries will be eligible for recycling. Veolia, with its historical expertise in battery and accumulator treatment, will mobilize its unparalleled knowledge across all stages of the recycling process. The solution involves five stages, including collection, secure storage, deep disposal, and refining of metals for reuse in new batteries. The recycling plant in Dieuze, France, dedicated to battery recycling, has significant development potential.

Toward Carbon Capture and Recycling

The capture, storage, and recycling of carbon are crucial mitigation options, even with maximum energy savings and a rapid transition to a greener energy mix. The Intergovernmental Panel on Climate Change (IPCC) affirms the essential role of these processes, particularly in the chemical and cement production sectors, stating that they are necessary to achieve carbon neutrality

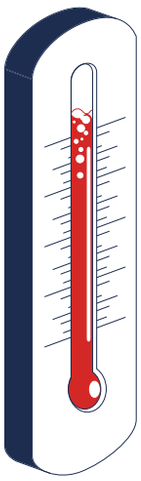
goals—especially those aiming to limit global warming to 2°C by 2100.[72] Veolia is exploring the application of carbon capture solutions in its waste recovery facilities, especially as carbon capture is becoming economically viable. Just five to seven years ago, there was a significant gap between the cost of carbon and the cost of capture, making it economically unfeasible to capture and store carbon. However, things are changing, with the price of carbon per ton increasing from 37.45 euros in February 2021 to nearly 90 euros in March 2023. Additionally, some countries, such as the UK and the US, are implementing mechanisms to incentivize the development of carbon capture infrastructure, whose costs are decreasing with economies of scale and the development of new technologies.

While any currently captured CO_2 is primarily intended for sequestration in underground geological reservoirs, Veolia aims to go further and valorize it. Isolated CO_2 molecules can be used in various industrial applications, such as concrete and cement production, carbonated beverages, and low-carbon fuels. Veolia has partnered with the Collège de France, the French Alternative Energies and Atomic Energy Commission (CEA), and the Inter-municipal Sanitation Syndicate of the Paris Agglomeration (SIAAP) for research and development projects to transform CO_2 emitted by wastewater treatment plants into useful products. The goal is to modify the molecular bonds through CO_2 chemistry to produce formic acid, used by the perfume industry, and methanol, a versatile solvent used in the production of varnishes and paints, in addition to biogas from wastewater. This alliance between fundamental, technological, and industrial research demonstrates the experimental stage of these efforts.

Overall, the solutions outlined here illustrate once again that the international climate and energy crises, which require a transformation of our production systems and habits, are resolved at the local level by replicating solutions developed worldwide. Veolia's ability to adapt and replicate solutions has made it a global champion in ecological transformation, a position that has been built patiently over decades since 1853 ●

72 — NIPPERT, Aline. "Ce que dit le GIEC sur les technologies de captage, de stockage et d'utilisation de carbone", *L'Usine Nouvelle*, April 12, 2022.

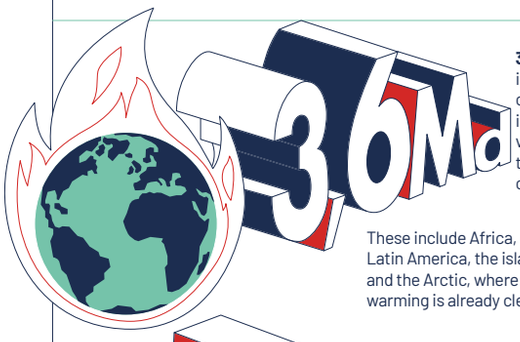
IPCC REPORT 2023:
AN ALARMING ASSESSMENT, POTENTIAL SOLUTIONS



+1,5 °C
Forecasted projections indicate that the global temperature increase of +1.5°C (2.7°F) compared to pre-industrial levels will occur as early as the beginning of the 2030s, regardless of the extent of immediate attempts to reduce global CO_2 emissions. However, urgent action is required to prevent further temperature rise and to reach the projected average global warming of +2°C (3.6°F) by 2100, as outlined by the IPCC.

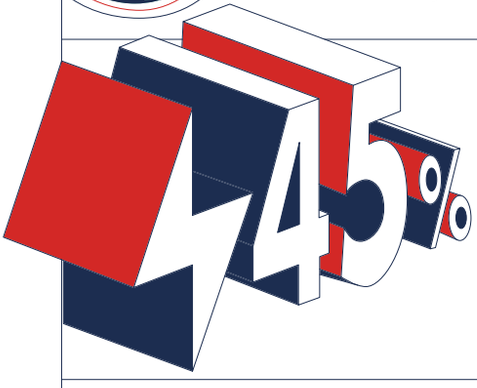
There is an urgent need to act.
The IPCC's report emphasizes that it is "possible, by taking action now, to preserve our future." However, global emissions must be reversed before 2025 to achieve the target of limiting global warming to 1.5°C.

56 gigatons
In 2019, global greenhouse gas emissions reached a staggering 56 gigatons, which is 12% higher than in 2010 and 54% higher than in 1990. Despite efforts to improve energy efficiency, the overall increase in activity across various economic sectors has outweighed the gains achieved. Fossil fuels and industry remain the primary sources of greenhouse gas emissions, which continue to rise.

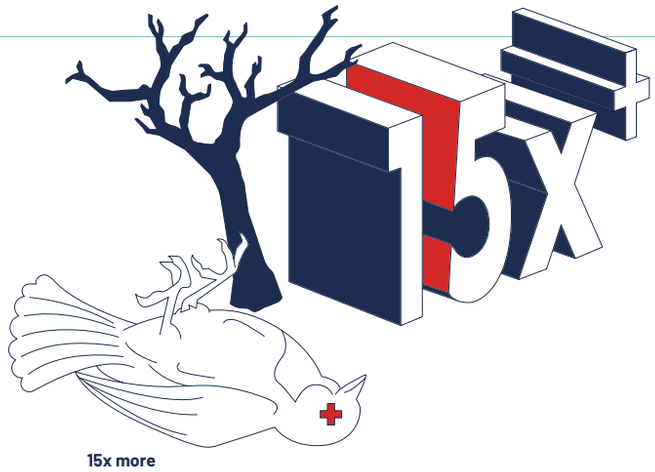


3.6 billion
is the number of people living in regions vulnerable to climate change.

These include Africa, Asia, Latin America, the islands, and the Arctic, where the impact of global warming is already clearly visible.



45 %
is the potential reduction in energy needs by 2050 through energy efficiency. Reducing energy demand is essential for lowering greenhouse gas emissions.



15x more
Ecosystems and populations are becoming increasingly vulnerable. Between 2010 and 2020, the mortality rate due to natural disasters and extreme heat waves was 15 times higher in vulnerable regions and countries. Adopting a low-carbon policy would have noticeable and rapid effects on air quality and public health.

To address these challenges, the following solutions exist:

• Reduce or even abandon the use of fossil fuels, for example, by eliminating subsidies still granted to them.

• Promote a diverse energy mix in territories by combining multiple types of energy sources such as solar, wind, hydropower, thermal, and chemical.

• Produce and encourage the use of decarbonized energy sources, such as reducing the costs of wind, solar, and electric power.

• Reshore energy production and production tools.

• Increase energy renovations and promote energy-efficient construction, including solar energy solutions.

• Prioritize green and sustainable mobility, such as electric or renewable gas vehicles and bicycles.

• Aim for energy efficiency and conservation, recognizing that the best energy is the energy not consumed.

• Foster international cooperation by providing financial and technological support to developing countries.

GERMANY

In Braunschweig, Biomass Replaces Coal

Germany has historically been a major consumer of coal, and this fuel has played a crucial role in its energy sector for many years. Coal has been used for electricity production as well as for industrial needs.

However, over the past few decades, the country has gradually embarked on an energy transition, known as the *Energiewende*, aiming to reduce its dependence on fossil fuels, including coal, and increase the share of renewable energy sources in its energy mix.

And it is in Braunschweig that the new energy story of the country is being written. This city in Lower Saxony is home to BS|ENERGY, a subsidiary of Veolia. As the concessionaire for the city's electricity and gas networks, it is committed to being at the forefront of energy supply by offering flexible, environmentally friendly, and affordable solutions. Its objective is clear: to support Braunschweig in its transition toward a future that is less dependent on carbon-based energy sources.

But how to replace coal? Among the preferred sustainable energy sources, biomass occupies a prominent place. The coal-fired heat and power production plant has therefore been replaced by a biomass cogeneration plant, fueled by wood waste from the region.

Commissioned in 2022, it has an electrical capacity of twenty-two megawatts and a thermal capacity of sixty megawatts, meeting the heat demand of nearly fifty thousand households. It helps to avoid the emission of eight thousand tons of CO_2 each year solely due to the abandonment of fossil fuels, as well as a reduction in harmful particulate emissions. Furthermore, the wood ash itself is transformed into fertilizer.

This initiative offers a glimpse of a more environmentally friendly, greener, more sustainable future, focused on renewable energy sources ●

FINLAND

In Finland, the Emergence of Carbon-Neutral Biofuel Production During the Paper Pulp Manufacturing Process

In 2022, Veolia launched the world's largest bio-refinery project in Äänekoski, Finland, producing carbon-neutral biomethanol from a paper pulp production plant.

Developed in close collaboration with Metsä Fibre, the largest forest cooperative association in Europe, the refinery relies on an innovative concept by Veolia to produce industrial-grade biomethanol from bioproducts on an industrial scale. This concept safely integrates a refining process of crude sulfated methanol into the paper pulp production process.

This industrial concept contributes to the energy security and independence of Europe, while supporting the European decarbonization ambitions of the Green Deal for transportation. Industrial-grade biomethanol, which is carbon-neutral, presents a new sustainable fuel source to replace fossil fuels.

With an annual production capacity of twelve thousand tons and expected commissioning in 2024, the plant will enable a reduction in CO_2 emissions of up to thirty thousand tons per year.

This bio-refinery project fully exemplifies Veolia's commitment to developing local energy loops and integrating solutions in various industrial sectors to locally produce carbon-neutral fuels.

Moreover, this industrial solution reveals the potential for an alternative source of raw material, estimated at around two million tons, for biofuel production. This concept, largely unexplored until now, can be replicated in nearly 80 percent of paper pulp plants worldwide ●

PORTUGAL

In Portugal, a Prospective Study to Transform CO_2 from Waste into Aviation Fuel

"In 2018, commercial aviation accounted for 2.6 percent of global greenhouse gas emissions and 5.1 percent of anthropogenic climate warming between 2000 and 2018 when the effects beyond CO_2 are included, according to Carbone 4, the leading French consultancy on energy and climate issues. The combustion of fuel alone corresponds to approximately one billion tons of CO_2 per year, roughly equivalent to the emissions of Japan—the third world power and fifth largest emitter."[1]

Aviation is therefore facing an immense decarbonization challenge, which cannot ignore the question of its fuel. That is why, in 2022, a feasibility study was launched to establish one of the first synthetic e-fuel production units in Europe within the energy recovery unit (UVE) of LIPOR, near Porto, operated by Veolia.

The project would enable the industrial-scale production of alternative aviation fuels (SAF) from CO_2 captured in the residual gas stream of the UVE, combined with green hydrogen. In the initial phase, up to 100,000 tons of captured biogenic CO_2 would be recycled to be converted into e-fuels and transformed into green synthetic end products such as e-kerosene, e-diesel, and other chemicals.

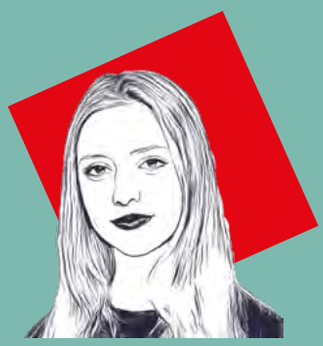
Technically, this CO_2 valorization project in the LIPOR UVE involves capturing, extracting, and purifying the biogenic part of CO_2, which constitutes approximately 60 percent of the carbon dioxide emissions generated following the incineration process.

According to the president of LIPOR, José Manuel Ribeiro, this project could "help Portugal position itself among the first countries to invest in the circular carbon economy," while, as highlighted by José Melo Bandeira, CEO of Veolia Portugal, "the capture, storage, or use of greenhouse gasses are essential" to achieve carbon neutrality goals.

While not a miraculous solution capable of resolving the competition between different energy uses, this project could contribute to addressing the climate challenge ●

1 — "Les idées reçues sur l'aviation et le climat", *Carbone 4*, October 11, 2022.

EMPLOYEE'S TESTIMONY



Adèle Peugeot

Employed at Veolia since 2022

FRANCE

Adèle Peugeot is a development and innovation project manager. A graduate of the École Normale Supérieure, with an MBA and a doctorate from the Collège de France, Adèle Peugeot believes in the collaboration between the research and industrial worlds, as well as in the importance of local action in addressing tomorrow's challenges. At Veolia France & Déchets Spéciaux Europe, she utilizes chemistry to serve sustainable development, particularly in decarbonization.

How can technology address the environmental challenges we face?

"If we want to collectively meet the challenge of a carbon-neutral world, we must leverage the complementarity between the research, innovation, and industrial sectors. While many solutions already exist, others will require new technologies. My daily work involves identifying innovative pathways that will enable the group to achieve its ambitions. This includes identifying potential partners among startups, university laboratories, technology providers, and more. Veolia, as an environmental services provider, plays a role in sharing concrete problems with these actors, guiding their trajectory toward solutions, and supporting them in the development and deployment of efficient processes. We have a responsibility to engage closely with these innovative actors, select the most suitable candidates, and bring their solutions to a maturity that allows for their application to our company's activities. We can be optimistic because, in many cases, these technologies are not fictional; they are currently being developed and are advancing rapidly. During my research years at the Collège de France, I was surprised to see how quickly discovery can progress."

What new solutions is Veolia currently deploying in the energy sector?

"The major challenge I am focused on is reducing greenhouse gas emissions, particularly CO_2 and methane—a gas that is twenty-eight times more warming than CO_2. To address this problem, there are already mature solutions, such as producing and utilizing low-carbon energies. The challenge is to deploy them on a large scale because, beyond decarbonizing specific regions, this will enable Veolia's activities in France to reach energy neutrality within five years. To achieve this, we are relying on various levers: producing more electricity and biogas from waste, installing photovoltaic panels on all available surfaces, and transforming used oils into green fuels.

> ***"We can be optimistic because in many cases these technologies are not fiction: they are being developed and advancing at a rapid pace."***

"We are also developing innovative solutions for longer-term application. These involve external partnerships, such as the one established with the Collège de France and the French Alternative Energies and Atomic Energy Commission (CEA). This partnership aims to develop a technology capable of converting CO_2 into chemicals that could be reused in our wastewater treatment plants. This would create an exemplary circular economy loop at the local level."

How is Veolia's long history an asset for the future?

"Veolia's core businesses are aligned with current societal challenges and are complementary to each other. Over time, the group has developed a decentralized model, deeply rooted in local regions, with teams who are close to local stakeholders and issues. This is a significant advantage for working toward ecological transformation. By remaining locally embedded, the ecological solutions implemented by Veolia will bring benefits to the planet and economic activity to the residents of each region."

Conclusion

© Dominique Robert Repérant

1194, Beynac Châtellenie.

In conclusion, let us allow ourselves to travel further back in time than we have done at any other point in this book and stop at an age when the modern concept of the "nation" did not even exist, in the heart of Périgord, where the crowns of France and England used the Dordogne River as their border.

During that year, Richard the Lionheart, King of England and son of Eleanor of Aquitaine, inherited this rich domain as a suzerain from his vassal without an heir. It is not entirely coincidental that he chose to assign it to Mercadier, one of his most loyal companions. This barony thrived with prosperity.

Beynac, with the Dordogne flowing through it, enjoyed an enviable location and natural resources. Before developing renowned fisheries for salmon, the local rulers exercised control over the river, which became navigable during the autumn and spring rains. They collected tolls from all passing boats and exported walnuts, chestnuts, and wine, as well as timber from the surrounding forests—a precious material used for countless objects and the primary source of energy at the time.

Perched atop a rocky promontory, the castle of Beynac has become a visible symbol of this prosperity throughout the centuries. Majestic, it overlooks the valley, a landscape that offers a breathtaking view to those who reside there. The view from its Éperon terrace in particular is unbeatable. The castle and the valley become one, impressing and evoking a sense of power. Behind the windows, seats were carved directly into the stone to ensure that no part of the spectacle was missed and for the castle's inhabitants to enjoy the natural light while engaging in reading, writing, or small manual tasks. No formal gardens were needed, neither in the French style nor the English.

Furthermore, the comfort of the place is reflected in the rammed earth floors, which required significant effort from the peasants tasked with gathering small stones from the surrounding fields and shaping them to ensure the proper composition. The luxury even extended to having dedicated rooms for latrines that directly discharged waste into the cliff—a privilege not always enjoyed even by kings themselves, as chamber pots were the norm.

Outside, the path leading to the lord's residence was paved with small stones, protecting those who traversed it from mud. One can hardly imagine the amount of human and animal strength required to sustain life in the castle atop the cliff with such a steep incline.

So, what can we take away from the history of this place that evokes so many others similar to it, even if they do not all sit at the crossroads of the histories of two countries, England and France, which have decisively contributed to altering our relationship with water and resources?

Primarily, we can learn three things. Firstly, the prosperity of a region is intimately linked to its respect for natural elements as much as the elements' domestication. Secondly, freeing oneself from pollution and associated sensory discomfort, from touch to smell, is fundamentally at the core of what humans seek to improve their condition. And finally, amidst all the quests for distinction, nothing surpasses the beauty of nature. These three fundamental realities, inscribed in history and geography, have shaped Veolia's convictions and vision of prosperity for the past one hundred and seventy years. These convictions are intended to be kept alive as Veolia fights against any sense of fatalism, determined in the face of immense challenges.

"As the ground beneath our feet is old and crumbling / For a second, we'll fight when it's late in the evening," sings the *chiffonnier* of soul music, British artist Rag'n'Bone Man, famous for his hit song "Human."

Veolia's teams are reaping the rewards of its rich history. At the same time, they are part of human society fighting for the essential at a key moment in history—a time when that society is facing the challenge of the century, animated, propelled, and unified by the optimism of combat ●

1 — « If the earth beneath our feet is old and caves in / For a second we will fight, when it's late in the evening », « As you are », 2017.

Acknowledgements

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• CAPRIS Renaud, directeur général d'Enova (Veolia).
• CARREY Julian, enseignant-chercheur et auteur d'un livre sur le techniques et énergie avant la société industrielle.
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The most critical challenges that humanity must face to ensure its future are the ecological ones. Revisiting the past allows us to address some essential questions for tackling them effectively.

How did a company initially dedicated to solving local sanitary issues evolve to incorporate the notion of the environment, including water management, waste, and energy? How have cultural, political, scientific, and technological advancements over the past one hundred and seventy years intersected to reshape our perception of what is essential and contribute to the transformation of our society?

How has a company rooted in French institutional culture successfully embraced a collective project enriched by experiences from every continents? How do chance encounters, failures, and crises continue to influence and shape its progress today?

These are the questions this book aims to explore by delving into the history of Veolia, which was born as the Compagnie Générale des Eaux on December 14, 1853, following a decree signed by Emperor Napoleon III. From the First Industrial Revolution to the present day, the history of these ecological pioneers, deeply intertwined with the larger history of the environment, is traced under the direction of historian Grégory Quenet, holder of the first chair of environmental history established within the French university system.

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