# Desalination: prospects for sub-Saharan Africa

19/03/2023

## Summary

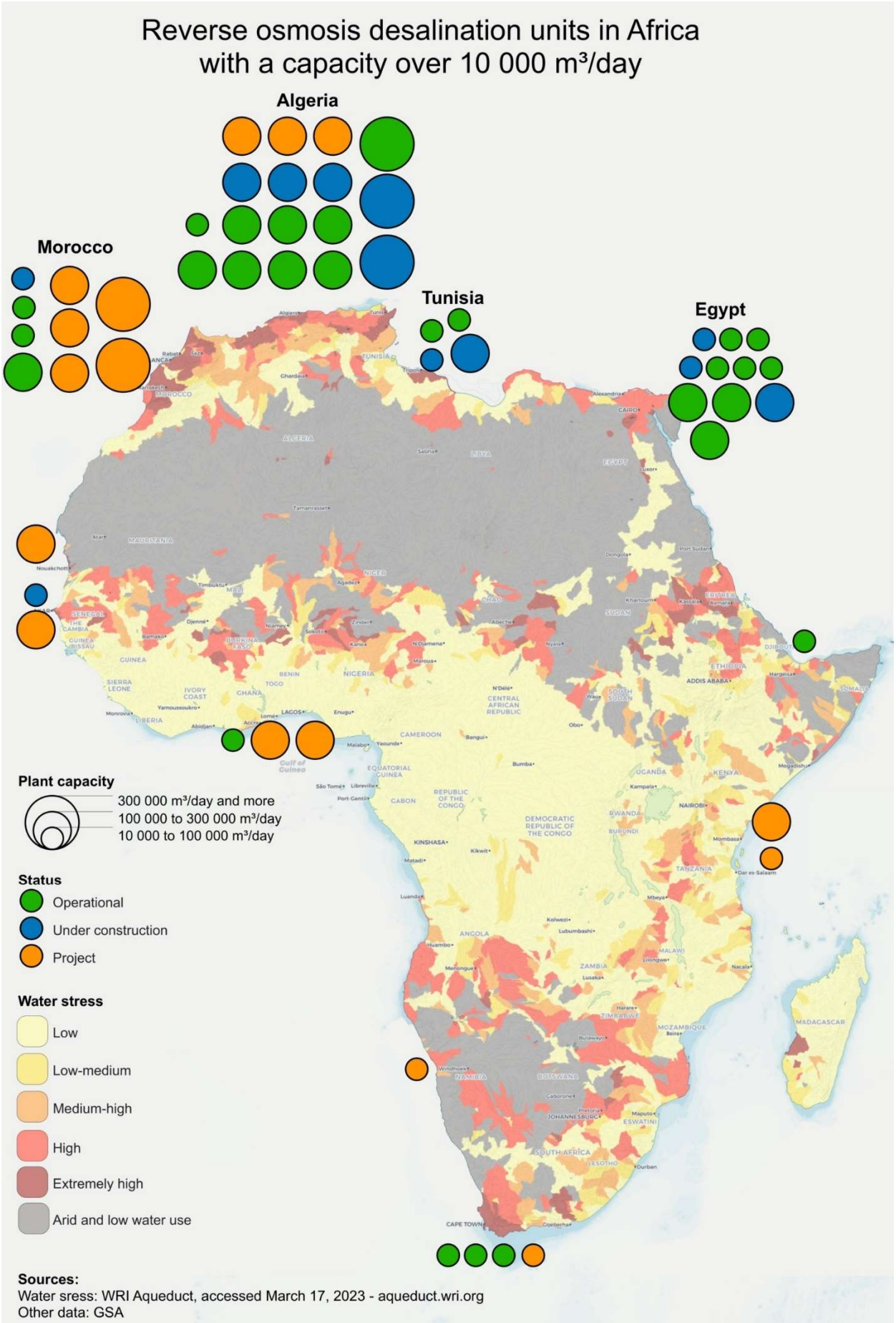
*Massively adopted in the Gulf since the 1970s, followed by by Israel or Singapore after 2000, large-scale seawater desalination remains little developed on the African continent, with the notable exception of the Maghreb, Egypt and, to a lesser extent, South Africa.*

*Capital- and energy-intensive, this technology remains difficult to make profitable without a significant increase in the water rate charged to users - unless it is heavily subsidised. It remains largely out of the reach of developing countries, and the few large-scale projects that have been carried out on the continent, outside North Africa, have a mixed record.*

*However, the rapid growth of large coastal cities in sub-Saharan Africa has in recent years prompted governments to launch ambitious desalination projects, with the financial support of development aid organisations or as public-private partnerships (PPPs). After the commissioning of a plant in Accra in 2015 and Djibouti in 2021, Dakar, Lomé and Cape Town are in turn betting on desalination to guarantee their populations' access to a vital resource, in a context of growing water stress that is jeopardising their conventional resources. Early-stage projects are also being studied in Mombasa, Luanda and Lagos, but they are faced with major financing difficulties. For their part, the North African "pioneers" continue to invest heavily (including, in Morocco, to meet the needs of the agricultural sector) to make up for recurring shortages that have led to episodes of social unrest.*

*Investment and operating costs, which are still high, are nevertheless falling steadily, and the use of renewable energies to power - at least partially - desalination plants is becoming feasible. These developments are gradually opening up new prospects on the continent. Several leading players, notably from the Gulf (ACWA Power, Metito, Wetico) or from Israel (IDE Technologies) are already positioning themselves in Africa, the new frontier of the desalination market.*

*Finally, the recent development of micro-power stations, containerised and powered by photovoltaic panels, makes it possible to produce drinking water on a very small scale in areas not connected to the electricity grid or to water distribution networks.*



# 1. Water stress: Africa headed for a worst-case scenario

Hydrologists consider countries, regions or cities where the available water resource is between 1 000 and 1 700 cubic metres ($m^3$) per capita per year to be in a situation of water stress, and speak of a shortage below this level. For comparison, in 2019, Algeria and Djibouti had 263 and 279 $m^3$ per capita per year respectively, compared to 10 600 $m^3$ for Cameroon and 73 000 $m^3$ for Gabon. In the same year, Senegal fell below 1 700 $m^3$ per capita[1]. This phenomenon, which North and Southern Africa have faced for decades or more, is developing in the rest of the continent, under the dual pressure of climate change and population growth. As early as 2007, the **Intergovernmental Panel on Climate Change** (IPCC) estimated that between 75 and 250 million people were likely to be under increased water stress. Nearly two decades later, the United Nations has retained the upper end of this range[2], while the World Meteorological Organisation (WMO) recalled in its "State of the Climate in Africa 2021"[3] that nearly *"418 million people still lack even a basic drinking water supply".*

Beyond the Maghreb and the Sahel - and to a lesser extent Southern Africa - the situation on the continent is characterised by strong local disparities, often linked to the accelerated growth of coastal cities. This is the case in Ghana - the first West African country to inaugurate a high-capacity desalination plant in 2015 - where, despite high rainfall and the presence of the Volta and Pra basins, the coastal region including Accra, Cape Coast and Takoradi is subject to "*moderate to high*" water stress, according to the Water Risk Atlas published by the American research institute World Resources Institute[4] . The same is true in Angola, where the explosive growth of the Luanda agglomeration - from 2.8 to 8.3 million inhabitants between 2000 and 2020 - has placed it in a situation of high water stress, or in the Cape region, affected by extremely high water stress.

# 2. A well-understood technology, numerous players

Two technologies are generally retained for industrial-scale desalination: the thermal method (also known as distillation), allowing the recovery of fresh water by evaporation; and the more recent reverse osmosis (RO) method, which consists in passing pressurised sea water through a membrane filtration system. The first is energy-intensive and better suited to warm waters with high salinity - hence its widespread deployment in the countries around the Persian Gulf. The second, better adapted to cold and less saline ocean waters, gained widespread adoption at the end of the 1990s, and now largely dominates the market. It consumes about half the energy of distillation, according to the World Bank (see box). These characteristics explain why this technique is now used by almost all the sites in operation or planned on the continent and intended for the production of drinking water.

This study has therefore focused on the use of this technology to produce water for human consumption. It does not cover the industrial uses of desalination (in the mining and energy industries, in particular) subject to very different technical and economic parameters.

The construction, maintenance and operation of large-scale reverse osmosis plants are mastered by numerous integrators around the world: Spain (Abengoa, Tedagua, Aqualia, GS Inima), Israel (IDE Technologies), the United States (GE), France (Suez, Veolia), Japan (Itochu, Mitsubishi), India (VA Tech WABAG), or Singapore until the bankruptcy in 2021 of its champion Hyflux. More recently, the expertise acquired by the Gulf States has allowed the emergence of credible competitors on the international scene: the Saudis ACWA Power and Wetico, the Emirati Metito or Almar Water Solutions (based in Spain but founded in 2016 by the conglomerate Abdul Latif Jameel). Some civil engineering companies (Eiffage) and energy companies (Engie, Taqa) have also positioned themselves on this market.

[1] Source: World Bank, *Renewable internal freshwater resources per capita*
[2] Source: United Nations, WMO: Climate change in Africa can destabilize 'countries and entire regions', September 2022
[3] Source: World Meteorological Organization, *State of the Climate in Africa 2021*, 2022
[4] Source: World Resources Institute, *Aqueduct - Water Risk Atlas*

The market for membranes - the heart of reverse osmosis plants - is much more concentrated. The market has long been dominated by Japan's Toray, Nitto-Hydranautics, and Toyobo, which in 2010 accounted for 56% of the market, according to a study by the Japan International Cooperation Agency (JICA), with their main competitor being the United States' Dow Water & Process Solutions. However, the strong growth of the market has exacerbated the competition: South Korea's LG Chem has become a major player (notably with the acquisition of the American NanoH2O in 2014) as has the American Koch Separation Solutions. In addition, some integrators have undertaken to acquire their own membrane manufacturing capacities. Suez, in particular, acquired GE Desal Osmonics in 2017 and then the membrane division of the German company Lanxess in 2020.

**This diversity of players, in permanent competition, gradually reduces costs. It also allows client states to limit their technological dependence on their supplier**.

## Highly variable costs

**The cost of a desalination plant depends on many parameters**: location, salinity and temperature of the collected water, additional costs related to the dispersion of brackish water, connection to distribution networks, etc. **The World Bank estimates that the construction of an RO plant requires between $1,200 and $2,200 per m³ per day of production capacity**[5]. **The operating cost, meanwhile, depends mainly on the price of energy**: between a third and almost half of the total according to the World Bank, or 44% on average according to the Advisian consultancy[6]. Between 3 and 7 kilowatt hours are needed to produce one m³ of water by reverse osmosis.

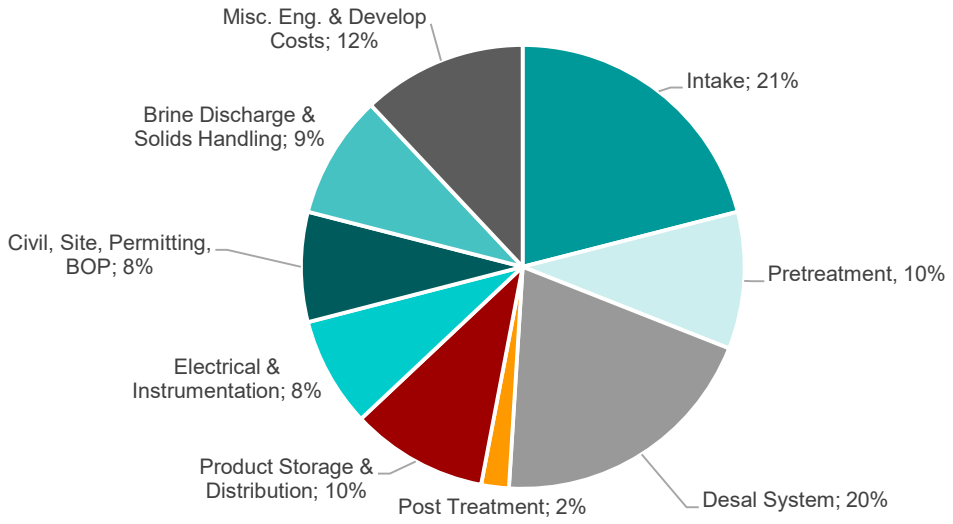
**Capital costs are another key component of the final bill** and vary according to the contractual terms chosen (PPP, turnkey delivery, etc.) and the possible availability of concessional financing. In this respect, Israel is a textbook case: the country, which produces most of its water by desalination, set up major financial facilities for PPP operators, whose activity is in turn closely supervised by the Water Desalination Administration (WDA), an ad-hoc entity bringing together the Governmental Authority for Water and Sewage, the Ministries of Finance and Energy, and other government bodies[7] .

These factors make it difficult to compare projects. The World Bank estimates that the most efficient RO plants had a total water cost of between $0.8/m³ and $1.2/m³ in 2016, but notes that some projects have reached much higher amounts ($2.86/m³ in Sydney). However, it points out that **the average price of desalinated water was halved between 1980 and 2008**, thanks to the development of reverse osmosis, a **considerable reduction in its energy consumption**, and continuous gains in membrane efficiency. **It believes that this trend will continue, with construction costs more than halving by 2040 and a substantial reduction in electricity consumption**.

The cost of desalinated water must also be compared with that of other production methods (groundwater capture, river or lake water purification, reuse, etc.). Here again, **the local context of each project is decisive**. For instance, the World Bank notes that the energy costs of a RO plant can be lower than those of transferring water collected several hundred kilometres away, particularly when the terrain is uneven. Water losses during transport must also be taken into consideration: they can favour desalination near a coastal town, or on the contrary make it prohibitive when it comes to supplying a town located inland.

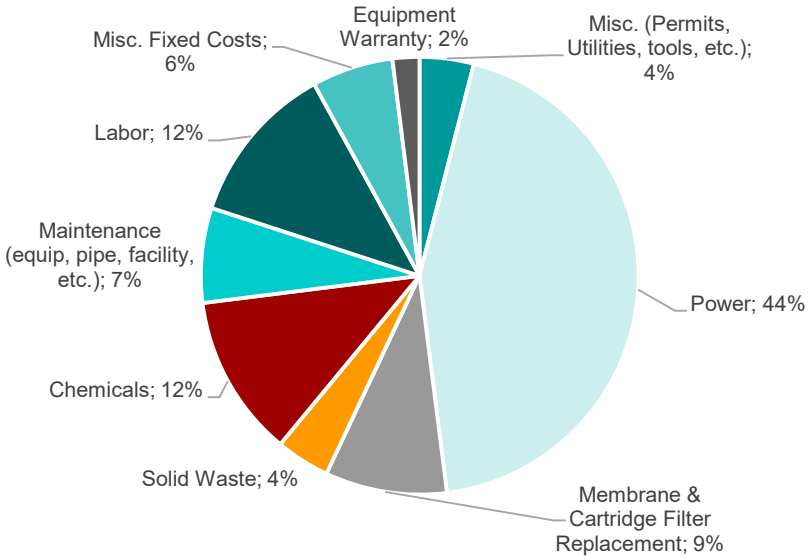
[5] Source: World Bank, *The Role of Desalination in an Increasingly Water-Scarce World*, March 2019
[6] Source: Advisian, Worley Group, *The Cost of Desalination*, 2018
[7] Source: Israeli Ministry of Finance, *Background - Seawater Desalination in Israel*, January 2021

**Figure 1: Typical SWRO desalination plant capital expenditure (CAPEX) breakdown**




*Source: Advisian*

**Graph 2: Typical SWRO desalination plant operating expenditure (OPEX) breakdown**




*Source: Advisian*

## 3. From Dakar to Djibouti, desalination as a last resort

The most recent project to be launched in sub-Saharan Africa, the Mamelles desalination plant in Dakar (Senegal), was awarded in June 2022 by national water authority SONES to a Japanese engineering company, Nippon Koei (prime contractor), which delegated the construction to France's Eiffage, India's VA Tech Wabag (in charge of the water treatment) and Japan's Toyota Tsuho Corporation.

**This solution was deemed necessary because of the major risks to the water supply of the Dakar-Mbour-Thiès triangle, which concentrates more than a third of the national population and 50% of the country's GDP production.** As the World Bank points out, *"Lake Guiers, which provides about 40% of the region's water supply, is threatened in terms of both quality and security of access*, while *"the aquifers supplying Dakar and its suburbs (currently providing nearly 50 per cent of needs)*" are faced with withdrawals *"3 to 4 times higher than their recharge rate, causing saline intrusion"* risking *"definitively compromising these aquifers both for domestic use and for irrigation"*[8]. According to the same document, *"the estimated withdrawals in the area* [of Greater Dakar] *are of the order of 268 000 m³/day, whereas the natural recharge capacity is estimated at only 83 000 m³/day"*. With its expected output of 50 000 m³/day - extendable to 100,000 m³ /day - the Mamelles project has therefore proved to be essential, in addition to other solutions (transfers from the Senegal River).

6,500 km east of Dakar, a similar situation led to the construction of the Doraleh power plant by Eiffage and Tedagua for Djibouti's ONEAD water and sanitation office, which was inaugurated in 2021. **The small, arid state, which is entirely dependent on its phreatic zones, has been in a situation of extreme shortage since 1992, with a 500 m³ /day/inhabitant, a volume that has been divided by three in two decades**. In Djibouti City (750,000 inhabitants, 75% of the national population), where needs are estimated at 60 000 to 100 000 m³/day, the supply system only delivered 50 000 m³/day in 2020. **The Doraleh plant's 22 500 m³/day therefore have a significant impact on the city's water security, while allowing Djibouti to reduce its dependence on Ethiopia - and on its Chinese creditor.** The 300km cross-border aqueduct inaugurated in 2017, built by CGC Overseas Construction (CGCOC) and financed to the tune of $327m by the Eximbank of China, supplies 100 000m³/day to Djibouti, mainly the southern regions of the country, but also the capital. Ethiopia provides the water free of charge, which gives it a certain diplomatic leverage.

## 3. External funding is essential, and hard to find

In both Dakar and Djibouti, the projects were only made possible by the massive financial commitment of development aid institutions. In Senegal, it is the **Japan International Cooperation Agency** (JICA) that is financing almost the entire project, through a concessional loan of approximately 205 million euros, at an interest rate of 0.7% spread over 30 years, with a grace period of 10 years. In Djibouti, the European Union's European Development Fund (EDF) contributed €73 million, while the Djibouti government contributed €5.5 million. The European Investment Bank (EIB) has also been asked to co-finance, alongside the EU, the second phase of the project, which should double its capacity to 45 000 m³/day.

Elsewhere in sub-Saharan Africa, several large-scale projects under consideration are struggling to find the necessary funding. In Kenya, the 100 000 m³/day plant that the Mombasa County Authority and Almar Water Solutions agreed upon in 2019 failed to materialize, as the $200 million needed have yet to be obtained - despite the free allocation of 4 hectares of land by the State, and a contract providing for the operation of the unit for 25 years by Almar, under the BOT (Build-Operate-Transfer) scheme. Just south of Mombasa, **Aqua Swiss** is facing the same problem with its Likoni contract (30 000 m³/day), also signed in 2019.

[8] Source: World Bank, *Challenges and Recommendations for Water Security in Senegal at the National Level and in the Dakar-Mbour-Thiès Triangle*, February 2022

In Nigeria, the Lagos metropolitan area is a "natural" candidate for desalination plants: less than 40% of its more than 22 million inhabitants had access to water by 2021, according to the governor of Lagos State[9] . The explosive growth of Africa's largest megalopolis has led to the overexploitation of its aquifers, and the lagoons surrounding it are partly brackish – and, therefore, much cheaper to desalinate than sea water. In 2014, the Lagos Water Corporation therefore entrusted the construction of a unit in Lewa to the Singaporeans Hyflux and Tolaram and negotiated a PPP with the Nigerian Brio and the Spaniards Acuamed and Tramasa for a high-capacity unit (200 000 $m^3$/day) on the Lekki peninsula. These projects never got off the ground; in addition to the difficulty of financing them - 288 million dollars for the Lekki project alone - they came up against criticism from NGOs denouncing the privatisation of access to water.

Finally, the city of Cape Town, in South Africa, has so far been unable to find the necessary resources for its plant project (50 000 $m^3$/day), valued at 135 million dollars. This unit has been under consideration since 2018 and was meant to take over from the three temporary modular plants which were hastily installed in 2018 and for two years, after three consecutive years of drought (2015-2017).

### Ghana's Teshie plant burdened by unbalanced PPP

Beyond the funds required for the construction of the plants, **their operation can prove very costly to the State when the contractual terms prove to be unsuited to their financial capacities, or too favourable to the operator.** Accra was the first city in West Africa to acquire a large desalination plant in 2015 (60 000 $m^3$/day) to supply some districts in the east of the capital. To finance this project, costing more than 120 million dollars, the Ghana Water Company (GWCL) has turned to a PPP scheme. The two companies in charge of the project, Spain's Befesa (then a subsidiary of Abengoa) and Japan's Sojitz, invested $18.75 million and $16.5 million, respectively, with South Africa's Standard Bank providing $87.5 million in debt; all of which was insured (to the tune of $179 million) by the World Bank's Multilateral Investment Guarantee Agency (MIGA)[10] . **However, the terms of the water purchase contract signed in 2012 quickly proved ruinous for the state-owned company: in addition to a fixed rent of $1.4 million per month[11] , it had committed to pay $1.37 per $m^3$ of water to the project company, an amount that was quickly raised to $1.46/$m^3$ due to energy costs**[12]. GWCL, however, charges its customers nearly five times less for water. The plant has also experienced numerous technical problems, operating at less than 40% of its nameplate capacity in the years after it was commissioned.

Teshie's disproportionate impact on GWCL's finances - denounced as early as 2015 by the utility's workers' union - led to a dispute with the concessionaire and the subsequent closure of the plant in early 2018, with the aim of renegotiating the terms of the contract. These talks are reportedly still ongoing, but GWCL has already secured a reduction in its fixed rent of around 40%, while refurbishment work brought the plant up to 76.4% of its design capacity in 2021. These developments have brought the overall price per $m^3$ to $1.17 - down from $2.88 in 2016. Despite this, the Teshie site continues to be a major drain on GWCL's finances, which estimates that it absorbs around 17% of its revenue, while representing less than 5% of its production capacity. GWCL remains unable to pay the concessionaire in full, forcing the Ministry of Finance to intervene ($23 million paid since 2015), without however absorbing all the arrears.

## 4. Growing interest in sub-Saharan markets

Despite these financial challenges, several new large-scale projects have been announced on the continent. Without waiting for the delivery of the Mamelles power plant, **Dakar is already planning the construction of a second unit, four times larger (200 000 $m^3$/day), under a PPP. Negotiations are underway with ACWA**

[9] Source: Premium Times Nigeria, *Less than 40% of Lagos residents have access to Water - Governor*, June 2021
[10] Source: World Bank, *Befesa Desalination Plant - project sheet*, 2012
[11] Source: Ghana Water Company Ltd, *Financial Report 2015*, 2015
[12] Source: Ghana Water Company Ltd, *Proposals for Review of Aggregate Revenue Requirement and Tariff*, December 2018

**Power**, whose reference shareholder is the Saudi Public Investment Fund (PIF). Well-established in the African renewable energy sector (South Africa, Morocco, etc.), the group has never before sought to export its desalination know-how, in which it is a leading player on its national market. In Senegal, its project could be concomitant with the construction, by ACWA Power, of a gas-fired power plant, which use the gas output of the Grand-Tortue-Ahmeyim offshore fields expected to start production at the end of 2024.

**Meanwhile, Togo signed in April 2022 a memorandum of understanding with AMEA Power for the construction of a 100 000 m³/day plant** a few kilometres east of Lomé. The Emirati group, which has already developed several renewable energy units in Africa (including a 50 MW photovoltaic plant in Togo), has no reference in desalination. It intends to finance 20% of the necessary investment - 180 million dollars in total - the rest to be covered by commercial and concessional debt. AMEA Power is currently negotiating the water purchase agreement with Togolaise des Eaux and hopes to complete the financing in November 2023,[13] with commissioning due two years later. The contractual arrangement - a 25-year BOOT (*Build, Own, Operate, Transfer*), repaid exclusively through the water purchase agreement - is similar to that used for the Teshie plant in Ghana.

**In Namibia, the Ministry of Water and Agriculture and the public water utility NamWater have validated in 2022 the principle of a PPP to build a second desalination plant in the Erongo region** (70 000 m³/day, estimated at $165 million), after abandoning plans to purchase the one built there in 2010 to supply the **Orano** (**ex-Areva)** uranium mine, and which now supplies other mining sites as well as the city of Swakopmund. The feasibility study, financed by the German development bank **KfW,** has been completed, but the project has been delayed, prompting the Sino-Namibian mining joint venture **Swakop Uranium** to offer, in February 2023, to participate in financing the new mine.

**Finally, Mauritania has been planning for several years to launch a gigantic PPP unit (up to 434,000 m³/day) to supply the capital, Nouakchott**, which faces recurrent shortages. This project - the financing of which remains hypothetical, with the authorities estimating it at some $3.6 billion[14] - is the subject of diplomatic competition between Morocco and Algeria, which are both vying to secure Mauritania's support in the Western Sahara conflict. Algeria offered its technical support during a visit by Energy and Mines Minister Mohamed Arkab in mid-2022[15] , while the Moroccan engineering firm ADI - a subsidiary of the energy company Nareva, owned by the royal holding company Al Mada - has, according to the Mauritanian press, been commissioned by the Mauritanian Ministry of Hydraulics to draw up the preliminary project studies and tender documents[16] .

# 5. North Africa is still accelerating, whatever the cost

## 5.1. Algeria

Algeria was the first African country to embark on large-scale desalination, and between 2008 and 2020 it commissioned eleven large units (ten of which RO) with a theoretical cumulative capacity of 2.2 million m³/day, for more than 2.8 billion dollars, carried out as PPPs. To ensure an acceptable cost of water, the concessionaires have benefited from heavily subsidised electricity, four times below cost, for the entire operating life of the plants[17].

This colossal financial effort has only been partially rewarded: a number of plants never reached their theoretical capacity, and some have even been shut down, leading to several legal disputes with certain

[13] Source: AMEA Power, *Project Presentation Sheet*, distributed by the Togo Ministry of Water, December 2022
[14] Source: Directorate General of PPPs, Republic of Mauritania, *Northern Zone Water Supply Project*, June 2022
[15] Source: Algeria Press Service, *Arkab in Nouakchott to examine the ways to strengthen bilateral relations in the fields of water resources and investment,* June 2022
[16] Source: La Dépêche de Mauritanie, *Adi is working on a seawater desalination project in Nouakchott*, September 2022
[17] Source: Miklyaev Jenkins, Adesina, Cambridge Resources International Inc, *Ex-post evaluation of the Algerian SWRO Desalination PPP Program*, August 2022

operators, notably the Singaporean group Hyflux and the Malaysian group Malakoff Berhad. The largest of these plants (Magtaa, 500 000 m³/day), in particular, will require major rehabilitation work[18] .

**In spite of this, Algeria has launched, after having suffered a new episode of water shortages in several large coastal cities in the summer of 2021, a new round of construction of at least eight new stations**, including five 300 000 m³/day mega-stations. Emirati company Metito has obtained the Boumerdès contract (80 000 m³/day) and Saudi company **Wetico**[19] those of El Tarf and Bejaïa (300 000 m³/day each). The authorities hope to be able to cover 60% of the country's drinking water needs through desalination by 2030.

## 5.2. Morocco

Starting much later than its Algerian neighbour, Morocco commissioned its first supersized plant (275 000 m³/day) in Agadir in January 2022. This infrastructure, built by Abengoa (which recently sold it to the authorities), has the particularity of producing, in addition to the drinking water supplying the city, 125 000 m³/day of water dedicated to the irrigation of 15 000 hectares of agricultural land. On the strength of this first experience, **the kingdom has launched other major programmes, in Dakhla in the Western Sahara** (90 000 m³/day, entrusted to Engie and Nareva) **and above all in Casablanca, where it wants to equip itself with a 548,000 m³/day unit, extendable to 822,000 m³/day** - which would make it one of the largest in the world. Six consortia are positioned in this market, one of which is led by the Israeli leader IDE Technologies, which hopes to take advantage of the recent normalisation of relations between Morocco and Israel to land its first African market. At least four other large units of more than 100 000 m³/day are also envisaged, one of which in the Oriental region could reach 680 000 m³/day. This one is particularly political: in 2016-2017, the region was the epicentre of the most severe protest movement experienced by the kingdom in years, fuelled in particular by recurrent water shortages in its cities.

## 5.3. Egypt

Under severe water stress, Egypt also fears a reduction in the flow of the Nile due to the construction of the "Renaissance" mega-dam by Ethiopia, which will be inaugurated in 2020. Cairo has therefore decided to reserve the river's waters for irrigation and to supply the population by other means, notably desalination. On a national scale, the country's total production capacity is nearly 900 000 m³/day, carried by more than 80 desalination stations, including a few large units, such as those of El Alamein and Al Galala (150 000 m³/day each) and a constellation of small units supplying the tourist industry in particular. The projects, which are multiplying, are mainly concentrated in the governorates of Matrouh, the Red Sea and Sinai (North Sinai and South Sinai). In this last region, President al-Sissi has inaugurated four stations in Nuweiba (15 000 m³/day), Dahab (15 000 m³/day), Ras Sudr (30 000 m³/day) and Abu Zenima (20 000 m³/day) in September 2021.

But Cairo's ambitions are much greater: the authorities had announced that they wanted to build 17 PPP plants by 2025, in order to increase capacity to 3 million m³/day, then 6.5 million m³/day by 2050. At the beginning of December 2022, they therefore mandated the Egyptian Sovereign Wealth Fund to mobilise the necessary funds (3.3 billion dollars for the first phase alone) from foreign partners. Gulf sovereign funds such as the Saudi Public Investment Fund, the Qatar Investment Authority or the Abu Dhabi Developmental Holding Company, have reportedly expressed their interest. The financial and budgetary crisis which is hitting Egypt is likely to disrupt these great ambitions, however.

The Egyptian executive is also considering building one or more desalination plants near the Al Dabaa nuclear power plant, which started construction in 2022 and is due to come on stream in 2026, to benefit from a permanent and low-cost power supply.

[18] Source: Africa Intelligence, *Dar Group comes to the rescue of Magtaa plant*, November 2021
[19] Source: Algérie Eco, *Desalination: Saudi Wetico wins two contracts in Algeria*, February 2023

### 5.4. Tunisia

Finally, Tunisia has launched the construction of two large power plants in Sfax (200 000 $m^3$/day) and Gabes (50 000 $m^3$/day). The first project is financed by JICA while the second is supported by the African Development Bank (AfDB), respectively. These units will more than double the national desalination capacity.

## 6. Renewables and mini-power plants, the new frontiers

Faced with the high energy cost of desalination plants, States and operators alike are exploring the possibility of powering them with renewable energies, in particular photovoltaic and wind power. In Morocco, the Dakhla project originally included a wind power plant, while the operating company of the Agadir plant, SEDA, had issued restricted calls for tenders to sign power purchase agreements (PPA) with renewable energy producers. In practice, however, the intermittent nature of wind and solar energy makes it virtually impossible to power desalination plants exclusively with renewables. This is because RO technology, when deployed on a large scale, is designed to operate continuously, with intermittent use causing accelerated wear and tear on the systems. The large amount of capital required for their construction also means that they must be operated continuously to achieve profitability.

**In practice, therefore, large power plants, which consume several tens of MW, must necessarily be connected to the high-voltage electricity grid. Renewable energy, generated via ad-hoc wind or solar farms or acquired via PPAs, can however prove very interesting in bringing down the average production cost**.

Globally, the share of renewable energy used in desalination operations remains marginal: only 1% in 2017, despite the Global Clean Water Alliance's ambitious goal of powering 20% of desalination plants with renewable energy between 2020 and 2025[20].

The situation is different at the other end of the spectrum, where we have been witnessing a real **boom in small-scale, decentralised and modular solar desalination** for several years. A myriad of local projects is flourishing on the continent. These small-scale projects (a few hundred $m^3$/day, intended for a few tens of thousands of consumers at the most), can concern the supply of a neighbourhood, a village or a defined economic project (hotel, tourist complex, breeding, agriculture, etc.). These installations are not necessarily connected to local electricity grids, while the modular nature of the units allows for a certain degree of itinerancy. Acting in concert with local partners or in the form of a consortium, the players in this market, who have developed competing technologies, benefit from a variety of funding sources: national or foreign development agencies, the United Nations Development Programme (UNDP), associations, private companies, etc.

Companies and projects alike are multiplying: America's GivePower in Kenya, Italy's Genius Watter and the Ugandan firm Aptech Africa in Somalia, the Finnish company Solar Water Solutions in Namibia... Germany's Boreal Light markets its Winture Planet Cube system that can supply anywhere between 1 and 30 $m^3$ of water per hour. The company is present in Kenya and is also looking to expand into Tanzania, Madagascar and Somaliland. The French company Mascara claims, with its Osmosun technology, a desalinated water production capacity of up to 600 $m^3$/day. The company has a strong presence in Africa, notably in Madagascar, Somalia, Senegal and South Africa. In Mozambique, Kenya and Tanzania, the Dutch firm Elemental Water Makers has set up several projects to supply villages or tourist complexes. Finally, South Africa's NuWater claims to have the largest rental fleet of industrial water treatment units on the continent, with systems of all sizes.

[20] Source: Institut français des relations internationales, *Geopolitics of seawater desalination*, September 2022