CASE STUDY PPP FOR CITIES
SEPTEMBER 2019

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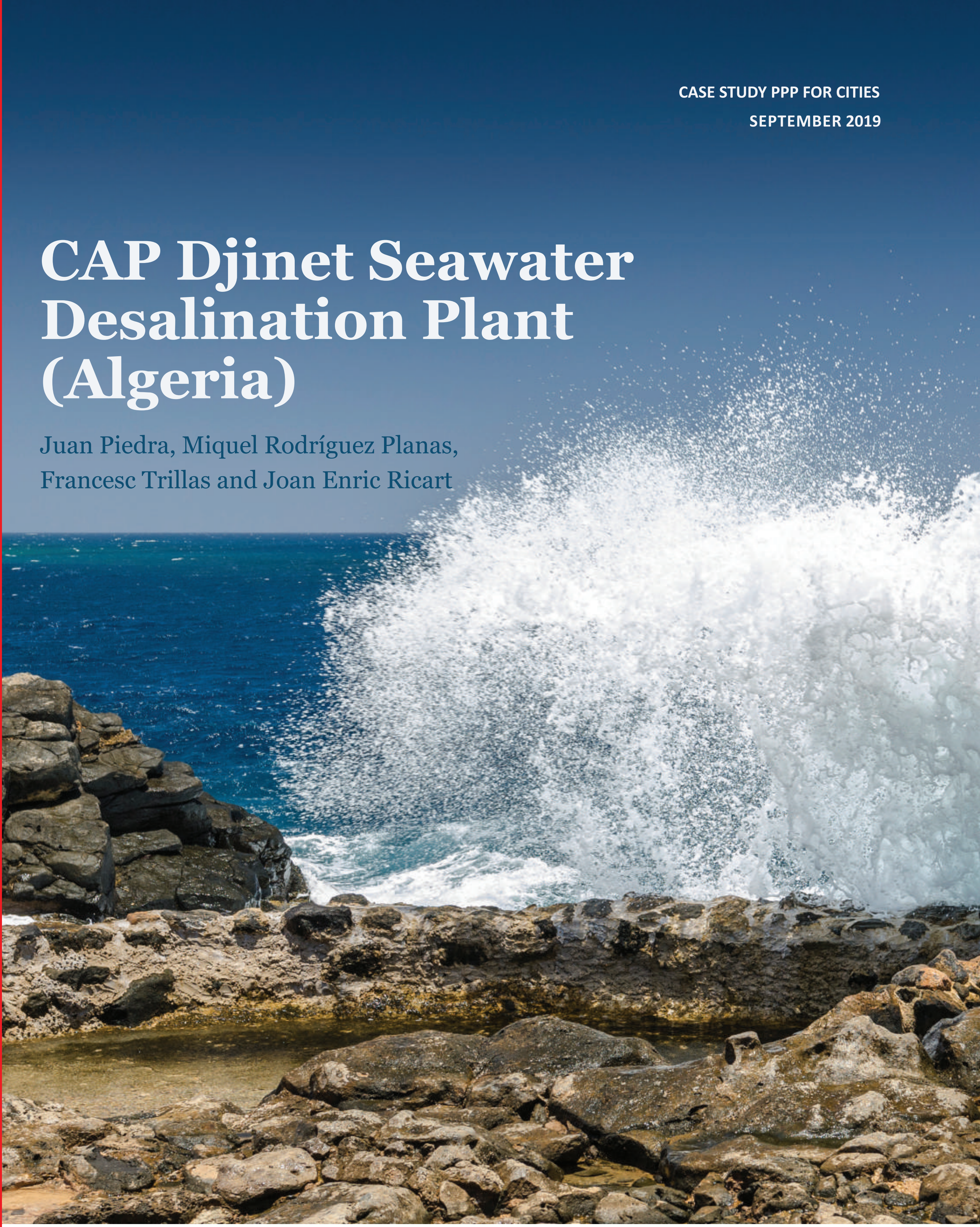
Juan Piedra, Miquel Rodríguez Planas, Francesc Trillas and Joan Enric Ricart



IESE Business School
University of Navarra

PPP for CITIES
Specialist Centre on PPP in Smart and Sustainable Cities

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The Specialist Center on PPPs in Smart and Sustainable Cities (PPP for Cities) is a research, innovation and advisory center whose purpose is to provide government agencies around the world with support in the organization, management and development of collaborative projects between the public and private sectors, in the field of smart cities.

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This document was prepared by Public–Private Sector Research Center, as document of interest for PPP study rather than to illustrate either effective or ineffective handling of an administrative situation.

This document has been created with the information facilitated by FCC Aqualia.

DOI: https://dx.doi.org/10.15581/018.ST-523-E

Working Team

Juan Piedra
Research Assistant

Miquel Rodríguez Planas
Manager of Public-Private Sector Research Center

Francesc Trillas
Associate Professor at UAB

Joan Enric Ricart
Professor of Strategic Management at IESE Business School

CONTENTS

List of Acronyms

ADE: Algerian water authority (Algérienne des Eaux)
AEC: Algerian Energy Company
BDL: Banque de Développement Locale
BNA: Banque Nationale d'Algérie
CPA: Crédit Populaire d'Algérie
DBFOMT: design, build, finance, operate, maintain and transfer
DZD: Algerian dinar
EPC: engineering, procurement and construction
FAO: Food and Agriculture Organization of the United Nations
ICC: International Chamber of Commerce
MENA: Middle East and North Africa region
MSF: multi-stage flash desalination
O&M: operations and maintenance
ONS: Algerian Office of National Statistics
OPEX: operating expense
PPP: public-private partnership
RO: reverse osmosis
SMD: Shariket Miyeh Ras Djinet S.p.A.
Sonatrach: Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures
SPV: special purpose vehicle
UN: United Nations

Summary

The Cap Djinet Seawater Desalination Plant was a project located in Cap Djinet, a cape of the Mediterranean Sea near the town of Djinet, Algeria. The plant was part of a major desalination program launched by the government in 2002 to face the severe water scarcity in the country.

Being a country mostly covered by the Sahara Desert, Algeria has an uneven distribution of water resources—mainly distributed in the northern regions and resulting in a massive concentration of the population in this area. In addition, these water resources have come under severe pressure over the years—due to continuous droughts, over-exploitation and management inefficiency—which led to a water crisis.

Previous attempts to solve this crisis were deployed by the government, including investment in the construction of small-scale desalination plants, but they had little success due to the bad planning of the program and the lack of experience and training of the personnel. The failed experience led the authorities to launch a massive program for the construction of large-scale desalination plants, with a daily capacity of 100,000 m^3/day to 500,000 m^3/day to supply water to the municipalities. To compensate for the lack of local experience, the plants were constructed under a public-private partnership (PPP) scheme, where the private firms brought the necessary know-how to guarantee the correct management of this valuable resource.

The Cap Djinet project started in 2004 and it was awarded to the consortium established by the companies FCC Aqualia SA and INIMA Environment SA. It took a total investment of US$138,029,900 and accounts a daily capacity of 100,000 m^3 of drinking water. The special purpose vehicle (SPV) created to design, build, finance, operate, maintain and transfer (DBFOMT) this plant was a public-private joint venture of the abovementioned firms that accounted for 51% of the shares. The state-owned Algerian Energy Company (AEC) held the remaining 49% and acted as the main promoter of the desalination program.

In this way, the PPP scheme benefited both sides of the partnership, as the private sector could provide the technology, expertise, investments and market efficiency while the public sector can provide off-take guarantees and co-investment and facilitate the necessary administrative requirements to fulfill the project without further delay.

Location: Cap Djinet, Algeria.

Characteristics of the PPP Contract

Project type: Greenfield.

Project capacity: 100,000 m^3 of drinking water per day.

Delivery mode: DBFOMT.

Total investment: US$138,029,900.

PPP contract value: US$671,104(47,028.8 million Algerian dinars).[1]

Bidding invitations: August 23, 2004.

Bid submission deadline: September 18, 2004.

Association agreement start: May 15, 2006 (signed between Aqualia, INIMA and AEC).

Contract start: July 4, 2007.[2]

Operation start: July 4, 2012.

Duration: Engineering, procurement and construction (EPC) + 25 years of operations and maintenance (O&M).

Payment method: purchase by ADE-Sonatrach of the daily production of water from the SPV, established by a take-or-pay (water purchase) contract.

Contracting authorities: Algerian water company (Algérienne des Eaux) (ADE) (https://www.ade.dz/) and Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (Sonatrach) (https://sonatrach.com/).

[1] Exchange rate Algerian dinar/US dollar as of July 7, 2007: 0.01427.

[2] The delay in the contract start was due to setbacks in signing the SPV Association Agreement and the final contractual package.

Awarded Company

Awarded consortium (SPV): Shariket Miyeh Ras Djinet S.p.A. (SMD).

Consortium members: FCC Aqualia SA and INIMA Environment SA

EPC contractor: UTE Cap Djinet.

O&M contractor: UTE O&M Cap Djinet.

Members: FCC Aqualia SA and INIMA Environment SA

Lenders: Banque Nationale d'Algérie (BNA); Crédit Populaire d'Algérie (CPA) and Banque de Développement Locale (BDL).

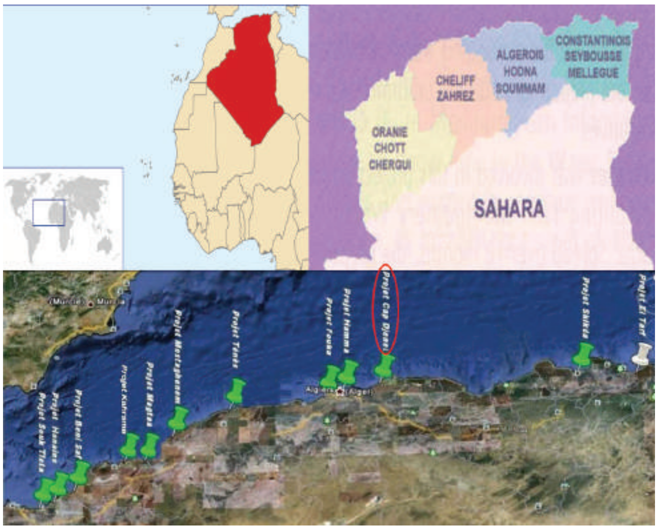
1. Background of the Project

1.1. Project Location

The Cap Djinet Seawater Desalination Plant was located 70 km east of Alger, on the Mediterranean coast (see **Figure 1**). The region consists of 48 provinces (called *wilayas*).

Regarding the climate and hydrology, the northern zone of the country, called the Tell—where the Cap Djinet plant is located—presents temperate Mediterranean climate, and it is Algeria's most humid and most populated zone.

Figure 1. Water Desalination Plants

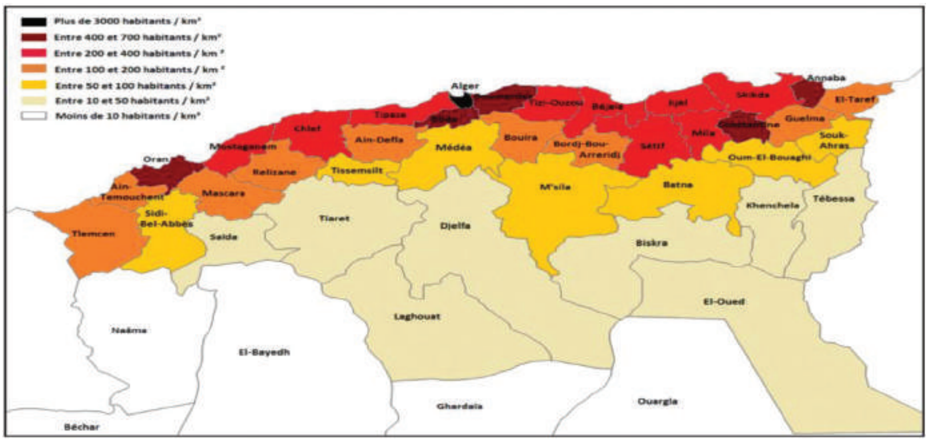


Sources: Retrieved from Drouiche et al. (2011) https://link.springer.com/article/10.1007/s11269-011-9836-8; Wikipedia https://en.wikipedia.org/wiki/Algeria; AEC (2017) http://www.mile.org.za/QuickLinks/News/Presentations%20IntraAfrica%20Water%20Desalination%20Works/Seawater%20desalination%20in%20Algeria.pdf. Retrieved October 10, 2018.

1.2. Seawater Desalination in Algeria

Algeria is the second largest country in Africa, with an area of around 2.3 million km^2. However, it presents an uneven spatial distribution of water resources, concentrated mainly in the northern regions of the country, where around 80% of the population live, as shown in **Figure 2**.

Figure 2. Population Distribution in Algeria



Source: AEC (2017). Seawater desalination in Algeria. Retrieved Octuber 10, 2018 from http://www.mile.org.za/QuickLinks/News/Presentations%20IntraAfrica%20Water%20Desalination%20Works/Seawater%20desalination%20in%20Algeria.pdf.

Nevertheless, water resources in the country are scarce; until 2004, the main sources of drinking water were water wells and water dams. The scarcity of water was aggravated by:

- seasonal and inter-annual irregularities in the rainfall, affecting the water reservoirs
- vast losses of water due to a lack of good management of resources and water networks
- insufficient and poor maintenance of the infrastructure[1]

The shortage of water affected mainly the population and irrigation of the farms, and in addition to the fast socio-economic development of the area, forced the authorities to take medium- and long-term decisions to solve the incipient water crisis.

The situation led the country's authorities to opt for a non-conventional water resource to obtain drinking water, such as the desalination of seawater. Seawater desalination was not new on the Algerian agenda. Algeria started investing in various desalination technologies in the 1960s, but most of them were destined for industrial use, principally for the oil and gas industry, as the country was relying on rainwater and the other water sources previously mentioned to provide fresh water for the municipalities.[2]

The government's first attempt to solve the water crisis after the drought of 1986 involved the construction of 21 small-scale desalination plants. According to the World Bank (2004) and Drouiche et al. (2011), this measure had little success, given the bad planning of the program and the lack of experience and training of the personnel. This is why, in 2002, the Ministry of Water Resources carried out the General Survey for Desalination, a study that aimed to define a desalination strategy for the short-, medium- and long term. Focused on 20 wilayas, it studied the feasibility of large-scale desalination plants with a capacity of between 25,000 m^3/day and 150,000 m^3/day to cover the water shortage, based on domestic, industrial and agricultural needs. Although this study did not address the feasibility of alternative solutions, some of the most important issues addressed were the following:

- Optimum location for the desalination plants
- Capacity of the plants
- Cost of the plants
- How construction should take place

In addition, to cover the lack of experience evidenced in the small-scale plants, the government decided that the construction of the large-scale plants needed a public-private partnership.

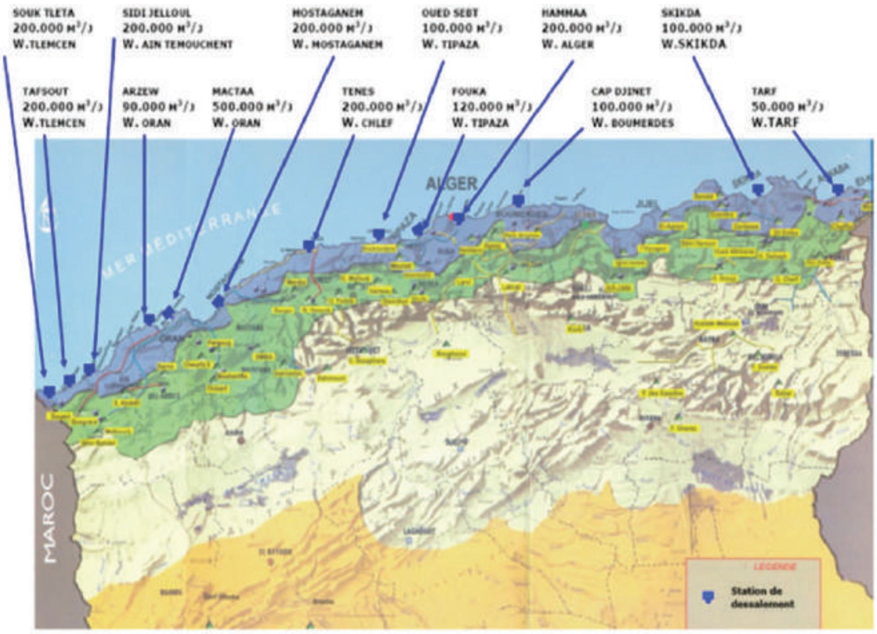
AEC and ADE carried out the new desalination program launched by the Ministry of Water Resources. This program covered the construction of sixteen mega-plants with a daily capacity of 100,000 m^3 to 500,000 m^3, based on reverse osmosis (RO) technology, to supply water to the municipalities.[3] Most of these projects were located in the Tell zone (see **Figure 3**), where, according to the Algerian Office of National Statistics (ONS), about 80% of the population is concentrated.

[1] World Bank, "Seawater and Brackish Water Desalination in the Middle East, North Africa and Central Asia: A Review of Key Issues and Experience in Six countries" (Vol. 2): Annex 1- Algeria (English), (2004), available at: http://documents.worldbank.org/curated/en/421161468191927352/Annex-1-Algeria.

[2] N. Drouiche, N. Ghaffour, M.W. Naceur et al., "Reasons for the Fast Growing Seawater Desalination Capacity in Algeria," *Water Resources Management* 25 (2011): 2743–2754.

[3] With a small percentage for industrial use.

Figure 3. Water Desalination Plants



Source: Retrieved from Drouiche et al. (2011).

1.3. The Water Desalination Program

The Cap Djinet Seawater Desalination Plant was part of the water desalination program deployed by the Ministry of Water Resources. The authorities in charge of overseeing the evolution of the program were ADE and AEC. ADE was an agency, set up by the Ministry of Water Resources, in charge of providing water to the country. Its main objectives were:

- Assuring population's potable water needs were met.
- Assuring the efficient management of the resources.
- Giving water its true value in order that the costs of management and operation could be recovered.

In addition, AEC acted as the main promoter of the water desalination program under a PPP scheme. It was a public company owned by Sonatrach and Sonelgaz. AEC was a project development company in charge of the promotion of large-scale projects in partnership with international firms that focused on seawater desalination and power generation.

Under this framework, AEC acted as a project sponsor in charge of the tender process and selection of firms. Also, it was a public partner that could hold up to 49% of the shares, supporting the project companies in their dealings with local administrations and establishing local and foreign funding in the project's financing process.

The constitution of a new partnership to develop a water desalination plant had to go through different steps (see **Figure 4**):

1. After the identification of the location, the need for water and the capacity of a new project, the tender process to call for investors was launched to identify a private partner with experience in the DBFOMT of the plant. This process followed two stages: the technical offer and the commercial offer.

2. Once the investors awarded the project, the association contract (PPP) between AEC and the investors for the execution of the DBFOMT contract and the project's financing basis is signed.

3. Then, the investors and AEC incorporated an SPV in the form of a joint stock company under the Algerian law, whose capital share would be majority-owned by the investors. AEC had a participation that can reach up to 49% of the shares.

4. The contractual package and the realization of the plant by the SPV were signed. These constituted the EPC and O&M contracts.

5. The financing agreement of the project was structured in the following way:

   - A 20% to 30% capital contribution to the SPV by the private partner and AEC.

   - 70% to 80% of debt.

   The financing of the project relied on its ability to generate predictable and regular cash flows that could cover the project operating expense (OPEX) over its lifetime (EPC + 25 years of O&M), covered the debt service and provided equity compensations to the investors.

Figure 4. Constitution of Water Desalination Project

Source: Prepared by the authors, based on AEC information.

The commercialization of the drinking water obtained was settled in a take-or-pay (water purchase) contract that ensures predictable and regular cash flows. The SPV produced a given volume of drinking water per day that was sold to Sonatrach and ADE, who have a commitment to buy the agreed volume of water.

Finally, the technology implemented for the desalination process was based mainly on an RO process, which had increasingly become a common method of desalination because it requires a lower level of energy consumption relative to other common methods, such as multi-stage flash desalination (MSF).

1.4. Project Specifications

This project was a PPP, codeveloping the DBFOMT of the Cap Djinet desalination plant through the corresponding SPV. The project included 25 years of infrastructure O&M. The SPV to be created for this project, along with the investors, was in charge of carrying out all the necessary procedures to obtain the required permits and authorizations before the operation of the first desalination unit started and to obtain their respective renovations throughout the lifetime of the project, whose expenses would be paid by the SPV. They were also responsible for establishing all the contracts with the organizations involved in the network setup in the place of construction—in particular for the water and electricity necessary for the construction, along with the telephone network.

Until the financial closure, the SPV and the investors had to provide ADE and Sonatrach with the environmental impact study previously delivered to the lenders, a report of the progress on obtaining all the permits and authorizations, and all the necessary documents for the design and construction of an external water transport and distribution network. Sonatrach and ADE were in charge of the construction and startup of this external water transport.

Once the last desalination unit was operational, and provided that the SPV and the investors were able to operate all desalination units simultaneously and that they produced at least 95% of the guaranteed capacity, the SPV and the investors would conduct the plant performance tests, which had to be supervised by an independent engineer appointed by the lenders. This engineer also had to confirm that all the desalination units fulfilled all the technical requirements for their operation. The independent engineer also supervised the performance tests of the external water transport network.

Thus, the project developed under three stages:

- EPC stage, both for the plant and the external water transport and distribution network
- Performance tests stage
- O&M stage

2. Tender Process

In August 2004, AEC released the call for tenders for investors to participate in the DBFOMT for a new desalination plant located in Cap Djinet that was to make use of the RO desalination process to satisfy the water needs of the country. The tender invitation established that the new plant should have a capacity of 100,000 m^3/day. The produced water would be sold to ADE and Sonatrach in accordance with the concession agreement.

The tender process involved two phases. The first one was a technical bid, where the investors provided a technical and economic proposal without any mention of the prices assigned to the cubic meters of desalinated water. This proposal had to come with the administrative documents required and a bank guarantee of US$300,000 or its equivalent of 24,600,000 Algerian dinars. The bid opening was public and AEC evaluated the proposals according to whether they were compliant with all the stipulations and conditions of the investor appeal documents, without any possible differences. AEC determined to what extent the proposal was compliant based on its content, without reliance on extrinsic evidence. The selected investors were called to the second step of the process, the commercial bid, which was due in a period not beyond of 15 days of the bid opening.

In the second phase, the commercial bid, the selected investors had to present three envelopes. These contained:

- the internal rate of return of the project (which could not be lower than 8%)
- the maximum price per cubic meter that would be charged to ADE and Sonatrach and the components of this price
- other administrative documents, along with a bank guarantee of US$1,000,000 or its equivalent of 82,000,000 Algerian dinars

The maximum price encompassed a part related to capacity and amortization and the payment of fixed operation and maintenance costs, and a part related to variable costs.

The evaluation of the commercial bid was public and was held right after the bid opening. To facilitate the benchmark between bids, all the proposals were converted to a single currency. The project was awarded to the firm that submitted the lowest price per cubic meter.

The commercial bid opening of the Cap Djinet desalination plant was held on October 31, 2005. Four investors were selected to participate in this phase:

- Aqualia in partnership with INIMA
- GE Ionics
- SNC-Lavalin in partnership with Pridesa
- GEIDA

The bids are summarized in **Table 1**.

Table 1. Commercial Bids

Investors	Aqualia +INIMA	GE Ionics	SNC-Lavalin +Pridesa	GEIDA
US$/m^3 fee	0.7275	0.7410	0.7520	0.7710
Total plant cost (millions of US$)	135.72	N.D.	159.00	158.00
Total EPC (millions of US$)	114.16	N.D.	N.D.	N.D.
Months to plant construction	20	24	24	24
Specific consumption in kWh/m^3	3.70	3.45	4.20	3.94
Ranking	1	2	3	4

Note: As we see in the table, the Aqualia + INIMA partnership was assigned first place in the tender, due to the minimum price proposed—the result of both lower fixed and variable costs for the plant.

Source: Prepared by the authors.

3. Internal Project Characteristics

3.1. Members of the Awarded Team

Aqualia

Aqualia started its operations in 1980 and was a company belonging to the FCC Group. The three main business areas of the FCC Group were environment, water and infrastructure.

Aqualia was the water management company of FCC. It was present in 22 countries, serving more than 22.5 million people in more than 1,100 municipalities. It was the leading company in full water cycle management in Spain, the fourth largest company in Europe and the seventh worldwide. In 2016, Aqualia's revenues amounted to around 1 billion euros.

Besides providing services in the municipal market, Aqualia had significant experience and a record of accomplishment in the EPC and O&M sectors. It had successfully executed more than 700 projects in these sectors in Europe, Latin America, the Middle East and North Africa.

INIMA Environment

GS INIMA Environment, SA, formerly OHL Medio Ambiente, developed and operated drinking water, industrial and recycled water plants, and salt and brackish water treatment plants. It participated in the DBFOMT of saline and brackish water desalination plants, industrial wastewater treatment plants, water treatment plants, pilot and experimental plants, reuse plants, sludge treatment and dehydration systems, and ultrapure and special water production plants. It had regional operations in Chile, Brazil, Mexico, Colombia and Peru. Since 2012, GS INIMA Environment had operated as a subsidiary of South Korea's GS Engineering & Construction Corp.

The beginning of its operations went back to 1955. It was the company with the most experience in RO water desalination plants in Spain, some of which account for a daily production of 200,000 m^3 of water or more.

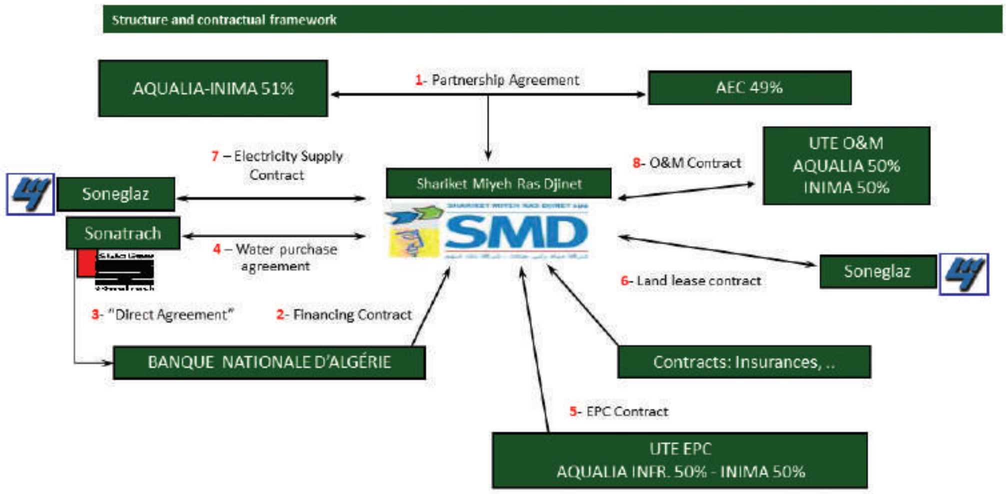
3.2. SPV Created for the Project

The Shariket Miyeh Ras Djinet S.p.A. (SMD) was a SPV created for the Cap Djinet desalination plant project. In this SPV, the private investors (Aqualia and INIMA) held a 51% stake in the company—shared in equal terms, with AEC holding the remaining 49%. The SPV is in charge of the construction of the plant, as well as its financing, management and commercialization of the water through the respective EPC (UTE Cap Djinet) and O&M (UTE O&M Cap Djinet) contracts. The contractors for the EPC and O&M were conformed on a 50% basis by each investor.

SMD was also responsible for overseeing the acquisition and setup of the necessary equipment and the know-how related to the process. It also had the obligation of managing the completion of all civil, real estate, industrial, financial, commercial and other operations related to the corporate purpose and enabling the development of the project. This means that the SPV was responsible for the contracts that ensure the completion of the construction and the correct development and management of the project, such as the required site where it was going to be built and the energy and water supply.[4] **Figure 5** summarizes the structure and contractual framework developed around the SPV.

[4] Energy supply and land contracts were established with the state-owned company Sonelgaz—the owner of AEC, in charge of the electricity and gas distribution in Algeria.

Figure 5. SPV Structure



Source: Information provided by Aqualia.

The lenders in the project—accounting for 80% of the funding—were Banque Nationale d'Algérie (BNA), as the main lender with 58% of the funding; Crédit Populaire d'Algérie (CPA), with 25%; and Banque de Développement Locale (BDL), with 17%. The financing agreement was signed on October 22, 2008.

3.3. Guarantee System

In this project, there was one guarantee that corresponded to the project's company (SMD): the EPC performance bond, which was deposited by SMD for an amount of US$10 million, payable in Algerian dinars, that remained valid for one year after the plant startup.

The guarantee could be executed by Sonatrach and ADE in the following cases:

- in the event of abandonment of the plant during the period prior to the company satisfying the plant performance tests
- if the company and the investors had not paid the penalties due under the contract
- if the company and investors had not paid any amount due to ADE and Sonatrach that was established in the contract

3.4. Finance and Funding

The Cap Djinet plant functioned as a non-recourse financing project; that is, no government guarantees were involved. The company had to cover its financial debts through its revenues; the lenders were entitled to step in if things went wrong. However, it is worth pointing out that, by being a public and private venture, it facilitated the development of the project with the public administration. In addition, ADE and Sonatrach as off-takers in the project represented a solvability guarantee to the financing institutions.[5]

The total investment of the project was US$138 million. To finance the project the leverage ratio was 80% debt, 20% capital. **Table 2** summarizes the sources of funding as well as their uses. The annual fixed interest rate established between the SPV and the financial institutions was 3.75%.

[5] Oxford Business Group, *The Report: Algeria 2010*, London: Oxford Business Group (2010).

Table 2. Sources and Uses of Funding (Thousands of US$)

Sources		
	Capital	27,606.00
	Credit	110,423.90
	Banque Nationale d'Algérie	64,045.86
	Crédit Populaire d'Algérie	27,605.98
	Banque de Développement Locale	18,772.06
Total		138,029.90
Uses		
	Investment in EPC	127,382.20
	Commissions and premiums	1,028.60
	Interest dividends (including taxes)	4,648.20
	Others	4,970.90
Total		138,029.90

Source: Data provided by Aqualia.

Note: Although the reference values are shown in US$, the debt was subscribed in Algerian dinar.

3.5. PPP Payment Method

In concordance with the water purchase contract, Sonatrach was under the obligation to pay for the produced quantity of water on a monthly basis. SMD agreed to produce a given quantity of marketable water to sell to Sonatrach and ADE, which was a guaranteed water production. The remuneration encompassed three components:

- capacity remuneration
- excess of capacity remuneration
- volume-based variable remuneration

Capacity Remuneration

Sonatrach paid compensation to SMD in relation to the real capacity of the plant.

The quantity of the capacity remuneration was calculated using the following formula:

$$RCx = PRD \times \sum_{i=1}^{n} CRi$$

Where,

RCx: was the remuneration of the capacity per month (x) in Algerian dinars.

PRD: was an availability premium expressed in Algerian dinars per cubic meter.

CRi: was the real capacity in days (i) in cubic meters.[6]

N: was the number of days of the month (x).

[6] The real capacity would be equal to the marketable water to be sold, and would be calculated in accordance with the guaranteed water production and any interruption in the production period that Sonatrach and ADE had been properly informed of.

Excess of Capacity Remuneration

In the event that the plant would be able, during the exploitation period, to offer an excess of capacity over a period greater than or equal to one year, and if Sonatrach and ADE expressed the interest of an additional levy of capacity, Sonatrach would remunerate the company by buying the excess monthly, in addition to the capacity remuneration. The excess of capacity remuneration was calculated as follows:

When CRi>CG

$$RCEx = 40\% \times PRD \times \sum_{i=1}^{n} (CRi - CG)$$

Where,

RCEx: was the excess of capacity remuneration payable for the month(s), in Algerian dinars.

CG: was the guaranteed production, in cubic meters per day.

n: PRD and CRi had the same definition as previously mentioned.

The obligation of ADE and Sonatrach to buy the excess of water produced was to be automatically annulled in the case that SMD could not accomplish the production of additional water in three consecutive months.

Volume-Based Variable Remuneration

Remuneration started with the commissioning of the first desalination unit. From the date of commissioning of the first desalination unit until the expiry of the exploitation period, Sonatrach would pay to SMD a monthly fee in accordance with the terms of billing established in the water purchase contract. The amount of the water production remuneration was calculated by applying the following formula:

$$RPx = Px \times (FE + FEEx / Px)$$

Where,

RPx: was the water production remuneration for the month (x), in Algerian dinars.

Px: was the amount of water delivered during the month (x), in cubic meters.

FE: were the water costs related to the operation of the plant for the month (x), in Algerian dinars per cubic meter. Water expenses cover variable operating and maintenance expenses related to the amount of marketable water.

FEEx: were the electrical power costs related to the amount of kWh consumed by the plant for the month (x), as defined in the formula below:

$$FEE_x = CS_{EE} \text{ x } P_{kWh} \text{ x } P_x$$

Where,

Px: was the amount of water delivered during the month (x), in cubic meters.

CS_{EE}: was the specific power plant energy consumption per cubic meter of marketable water.

P_{kWh}: was the regulated price of the electric power expressed in Algerian Dinar per kWh.

SMD had to perform a monthly system survey, where they had to develop all the records and details of the analysis and measurement system of the water capacity and production of marketable water.

In order to charge the monthly compensation, the company had to calculate and send, within the first seven days of every month, a bill in the name of Sonatrach with the total amount to be charged; which was equal to the addition of capacity plus the production remuneration and the excess of capacity remuneration, if any. The bill had to be sent to Sonatrach, along with a copy of the measurement system records, as well as a detailed report of the calculations.

3.6. Risk and Risk Mitigation

As in any PPP project, a proper assessment of the risk was a critical issue for the success of the service. In the literature, it is often said that the risk should be transferred to the part that can better deal with it.[7] **Table 3** shows the risk assignment according to category.

Table 3. Risk Assignment

Risk category	Assignment
Land and space	SMD/ADE-Sonatrach
Environmental	SMD/ADE-Sonatrach
Design and construction	SMD
Financing	SMD
Inflation	ADE-Sonatrach
Interest rates	SMD/ADE-Sonatrach
Exchange rate	ADE-Sonatrach
Operations and maintenance	SMD
Demand	ADE-Sonatrach
Political	SMD/ADE-Sonatrach

Source: Prepared by the authors.

Land & space risk

SMD was responsible for obtaining all the permits and authorizations necessary for the construction of the plant, which included the obligation to sign agreements necessary for the construction area. The contract for the land where the plant was to be built was signed between Sonelgaz and the SPV. However, ADE was in charge of previous studies that determined the locations for the construction of the plants, sharing this risk with SMD.

Environmental Risk

ADE, as a government entity in charge of the studies that identified the needs and location of the project in Algeria, was the organization that assumed this risk. However, SMD was in charge of employing the means necessary to minimize the impact. It also had to develop and deliver the environmental impact study to the lenders, ADE and Sonatrach.

Design and Construction Risk

SMD, basically Aqualia and INIMA, assumed the risk as investors who declared that they had the experience and knowledge necessary for the implementation of the plant. Their vast experience as two of the leading firms in water infrastructure helped to mitigate this risk. AEC as a public entity and part of the SPV had the role of facilitating all the administrative requirements for the construction of the plant.

[7] P. Berrone, X. Fageda, C. Llumà, J. E. Ricart, M. Rodríguez, J. Salvador, and F. Trillas, *Public-Private Partnership in Latin America: A Guide for Regional and Local Governments*, (CAF: Caracas, 2018), available at: http://scioteca.caf.com/handle/123456789/1220.

Financing Risk

SMD assumed the risk and financed the project through social capital and debt, which they repaid from the company's revenues. However, this risk might have been mitigated by the fact that ADE and Sonatrach were the exclusive buyers and were obligated to buy all the guaranteed production of water.

Inflation Risk

During the tender process Aqualia-INIMA defined the capacity remuneration and the variable OPEX, dividing the costs subject to two subcategories. The first subcategory included the costs of transactions in US dollars, which were indexed according to the US inflation rate and the US dollar/Algerian dinar exchange rate. The second subcategory included the costs of local transactions, therefore subscribed in Algerian dinars and indexed according to the Algerian inflation rate.

Thus, the inflation risk was assumed by ADE-Sonatrach, as the price and consumption level was initially established in the tender process to determine the costs, but they were forward indexed to the respective inflation and exchange rates.

Interest Rates Risk

During the tender process the administration established a pool of banks to be part of the financing agreement. In this financing, the interest rates were fixed throughout the whole concession period. Therefore, the administration, through ADE-Sonatrach as the contracting authority, assumed the interest rate risk. However, there was still a small risk assumed by SDM in the financing of the project that could be caused by unexpected changes.

Exchange Rate Risk

As previously mentioned, the costs established in the tender process were indexed to US inflation and the Algerian dinar / US dollar exchange rate, which was assumed by ADE-Sonatrach.

Operations & Maintenance Risk

This risk was assumed by SMD, the joint venture through which Aqualia and INIMA brought all the experience and the know-how to the project.

Demand Risk

ADE and Sonatrach, as the final buyers and those responsible for the final distribution of water, assumed the demand risk. They were also obligated to buy all the water sold by SMD, as long as the volume of water to be bought fell within the terms established in the water purchase contract.

Political Risk

ADE and Sonatrach assumed the political risk. Even though AEC worked as a public entity, it tried to ensure sufficient independence from the project. ADE, for its part, distributed the water for Sonatrach and paid them for the distributed water. ADE could not be the direct off-taker of the project, since its financial standing was not good enough to be a solid guarantor to international financers.[8] Still, there was a risk assumed by the private firm, deriving from potential political changes that could affect the project's profitability. This risk had been evidenced in similar water infrastructure projects developed in other countries, such as Egypt and Mexico.[9]

[8] World Bank, "Seawater and Brackish Water Desalination in the Middle East, North Africa and Central Asia: A Review of Key Issues and Experience in Six Countries (Vol. 2): Annex 1- Algeria (English)" (2004).

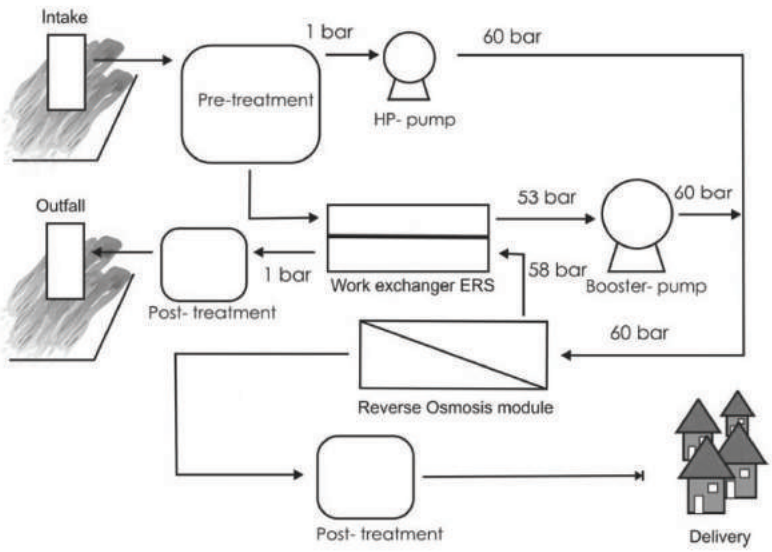
[9] J. Salvador, F. Trillas, J. Enric Ricart, and M. Rodríguez Planas, Interview with Rafael Pérez-Feito, International Operations Director, Aqualia, in *New Cairo Wastewater Treatment Plant (Egypt)*, (Barcelona: IESE, 2016), http://www.pppcities.org/wp-content/uploads/2017/12/ST-0425-E.pdf; J. Salvador, J.E. Ricart, F. Trillas, and M. Rodríguez, Interview with Rafael Pérez-Feito, International Operations Director, Aqualia in *El Realito aqueduct (Mexico)*, (Barcelona: IESE, 2018), http://www.pppcities.org/wp-content/uploads/2016/11/ST-0468-E.pdf.

3.7. Technical Elements

The capacity of the desalination plant is 100,000 m^3 per day. The technology implemented for the water desalination procedure is reverse osmosis (RO), which is a water purification technology that uses a semi-permeable membrane (a property of certain polymers) to remove ions, molecules and larger particles from drinking water by using a high-pressure pump. By creating a pressure difference across the membrane, the water contained is forced to permeate through the membrane. A high amount of pressure is required to overcome what is known as the feed-side osmotic pressure.[10]
The RO process includes different stages, as depicted in **Figure 6**. These stages are:

- water abstraction—in the case of the Cap Djinet plant, the seawater was captured by means of a submarine outfall
- pretreatment
- pumping system
- membrane separation unit
- energy recovery system
- posttreatment
- control system

Figure 6. Simplified Reverse Osmosis Scheme



Source: Retrieved from Fritzmann et al. (2007).

The water purchase stated that the quality of the water had to satisfy the minimum requirements; no defect in the quality of the water would be accepted by Sonatrach and ADE. The technical requirements were as follows:

- total hardness: 50 ppm to 65 ppm as $CaCO^3$
- alkalinity: 65 ppm as $CaCO^3$
- pH: 8 to 8.5
- Langelier index: 0 to 0.4

[10] C. Fritzmann, J. Löwenberg, T. Wintgens and T. Melin, "State-of-the-art of Reverse Osmosis Desalination," *Desalination* 216 (nos. 1–3), (October, 2007): 1–76.

The granted capacity had to be:

- for the first desalination unit (or any desalination unit running): 25,000 m^3 per day of marketable water
- for the plant: 100,000 m^3 per day of marketable water

The minimum performance of the plant (known as the technical minimum) would be equal to 25% of the granted capacity of the plant. All these performance guarantees would be carried out under the following conditions:

- barometric pressure, bar (abs): 1.013
- ambient air temperature, °C: 30
- air environment humidity, %: 76
- seawater temperature, °C: 24
- temperature of the discharged seawater, °C: 10, at the maximum above the temperature of the seawater

3. Governance

In this contract, as in any medium-long term contract in which different actors participate with priorities that may sometimes differ, the governance of the project was one of the key elements for the success of the project. Throughout the life of the project unexpected situations may have arisen that would have forced the parties to reach agreements on matters that were not initially considered. For this reason, contracts are considered incomplete, the longer the duration (Grossman and Hart, 1986). Having good governance mechanisms would ensure that the project progressed correctly over time.[11]

The association contract of the Cap Djinet desalination plant established that any controversy would be solved in an amicable manner between the two parties, within the first 10 days after the receipt of the controversy notification by either of them. The period of an amicable solution could not exceed 30 days after the notification, unless the two parties agreed otherwise.

In the event that the parties failed to settle their dispute at the end of the amicable settlement period, within 10 days of its expiry, they could, (i) submit the dispute to arbitration or (ii) if the parties so desired, agree to appoint an expert to solve the conflict.

In the first case, the parties agreed that any disputes should be definitively settled in accordance with the Conciliation and Arbitration Rules of the International Chamber of Commerce (ICC) by three arbitrators appointed in accordance with these rules, whose decisions would be final and not subject to appeal.

[11] J.G. Sanford, and O. Hart, "The Costs and Benefits of Ownership: a Theory of Vertical and Lateral Integration," *Journal of Political Economy* 94: 691–719; Oliver D. Hart and John Moore, "Property Rights and the Nature of the Firm," *Journal of Political Economy* 98: 1119–58; O. Hart and J. Moore, "Property Rights and the Nature of the Firm, *Journal of Political Economy* 98: 1119–58.

In the case of solution by an appointed expert, he or she would have the objective to:

- ascertain and verify the terms of the dispute, based on the declarations and documents submitted by the parties
- make any findings, verifications, requests for additional information, tests and analyses, as it deemed necessary
- make recommendations for the resolution of the dispute

Unless otherwise agreed by the parties, the expert should submit his or her report within 30 days of his or her appointment. If the parties disagreed with the conclusions, each party could, within 10 days following the submission of the report by the expert, submit the dispute to arbitration.

In the project, there were some setbacks that required the controversy solution. There were some delays in the construction and start-up phase of the Cap Djinet desalination plant. Among the main reasons for these delays were:

- the requests by the authorities to the company to build a life base with permanent private security within the plant, where all of its expatriate workers could live
- the request by the client for some modifications in the electrical substation
- the temporary prohibition of road transport of the sand filters of the plant due to its large size
- the temporary shortage of cement at the country level
- negotiations for the acceptance of some technical optimization proposals

Some of these delays, along with other aspects—such as the delay in the start of the operation due to the lack of completion by Sonatrach to take the desalinated water, and the sale and billing of the water produced in the start-up period, as well as the economic repercussion of power cuts—gave rise to a series of cross-claims between the SMD and Sonatrach. All of them were in process of resolution through a friendly negotiation between both parties and had not interfered with the start-up of the plant and its normal operation at the date of publication of this document.

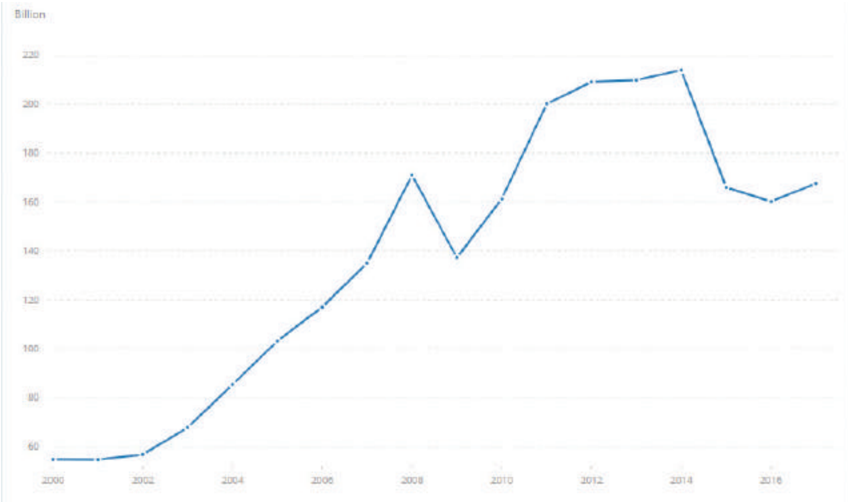
The flexibility of both parties was especially remarkable in a particularly complex geographical environment (the province of Boumerdés), where security was an important element to be taken into account in the construction and operation of the infrastructure, since it forced the entire expatriate workforce to reside within the perimeter of the plant—with 24-hour private security and a military escort for foreign personnel who moved outside the facilities.

4. External Project Characteristics

4.1. Economic Conditions

According to the World Bank, Algeria was the third largest economy in the Middle East and North Africa region (MENA).[12] The Algerian economy was characterized by an increasing Gross Domestic Product (GDP) over the years, except for two shocks in 2009 and 2015 (see **Figure 7**). The first coincided with the financial crisis of 2008, which the Algerian economy was able to overcome—thanks mainly to rising oil prices. The second happened in accordance with the deterioration of hydrocarbon prices. Algeria was overly dependent on hydrocarbon revenues, which fluctuated with volatile oil prices. In 2014—the year with the highest economic bonanza since 2000—oil and natural gas revenues reached almost 20% of GDP (World Bank data).

Figure 7. Algerian GDP, 2000–2017 (Current US$)

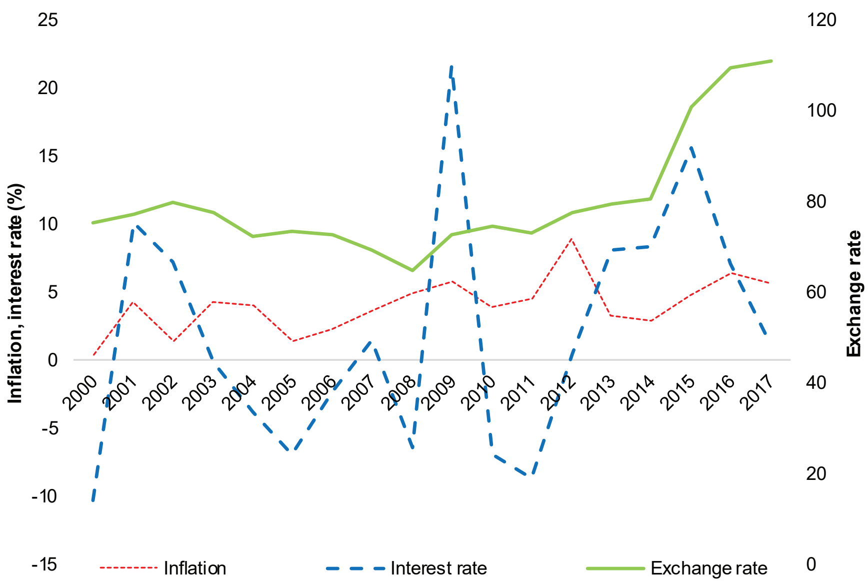


Source: World Bank database. Retrieved October 18, 2018 from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2018&locations=DZ&start=2000

The inflation rate was very volatile over the years, increasing during the period of the project that produced negative values in the real exchange rate, which also varied due to the irregular inflation rate (see **Figure 8**). Also, for the first part of the project, the value of the Algerian dinar appreciated until 2008, when a constant period of depreciation of the local currency started. The steepest depreciation trend can be seen from 2014 onwards, where the monetary authorities allowed the dinar to further depreciate with respect to the US dollar to prevent its misalignments, which also increased pressure on inflation.

[12] World Bank, "Middle East and North Africa Region," *MENA Economic Monitor* (April, 2018), http://documents.worldbank.org/curated/en/146731523302324108/pdf/replacement-PUBLIC-MENA-Economic-Monitor-April-2018-final-without-Jordan.pdf.

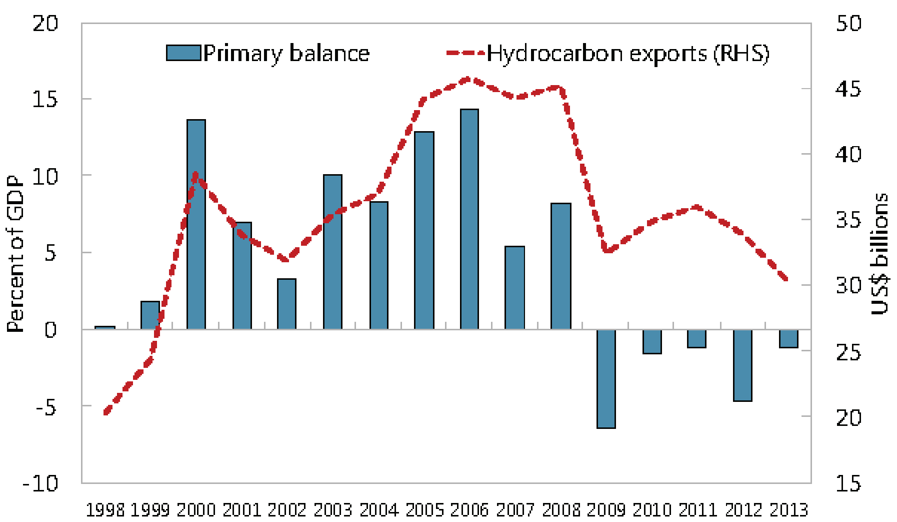
Figure 8. Inflation, Interest and Exchange Rates



Source: Prepared by authors. Retrieved October 18, 2018 from World Bank database https://data.worldbank.org/

Until 2008, the country showed a positive fiscal balance (see **Figure 9**). This was enhanced by higher revenues coming from the oil exports, which saw a serious drop in 2009 due to a deficit in the primary balance that continued over the following years.

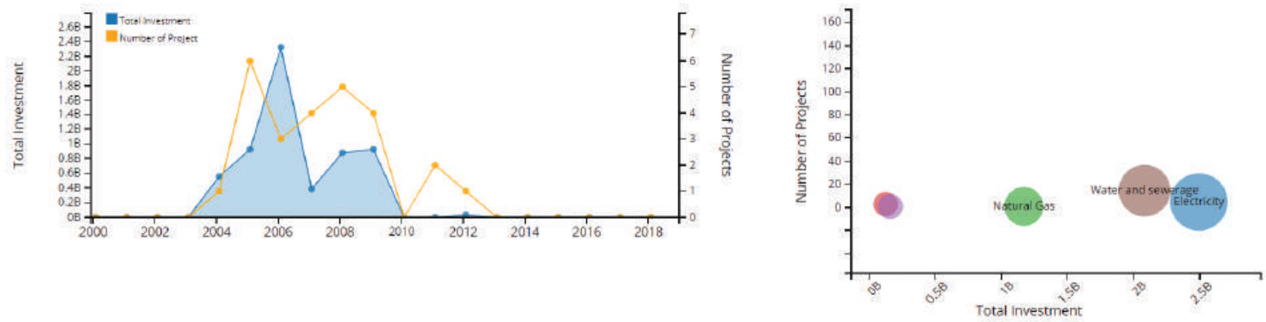
Figure 9. Primary Fiscal Balance and Hydrocarbon Exports



Source: International Monetary Fund. Retrieved from IMF (2014). Algeria selected issues.
https://www.imf.org/external/pubs/ft/scr/2014/cr14342.pdf

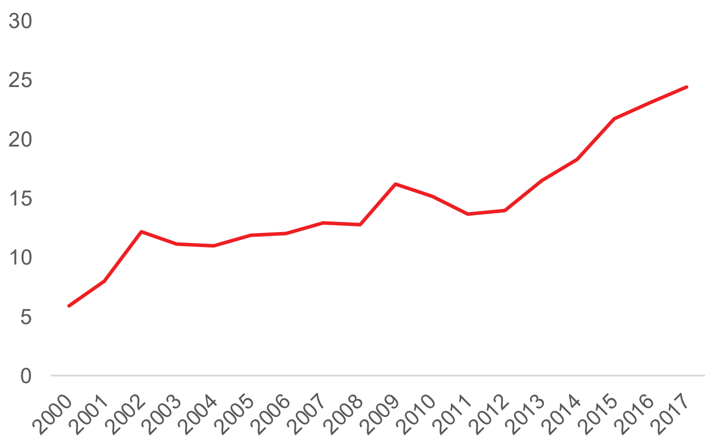
The oil price boom allowed the country to accomplish major achievements, enabling the authorities to pay the international debt and invest in infrastructure projects to improve the country's well-being and attract private investment. The Cap Djinet project took part in this period, where private participation in infrastructure reached its highest value, between 2003 and 2010 (see **Figure 10**). The highest percentage of this investment was made in the electricity sector and water and sewage sector. These investments were accompanied by an increase in domestic lending to the private sector, which started in 2004 (see **Figure 11**).

Figure 10. Private Participation in Infrastructure (in US$)



Source: Retrieved from World Bank Private Participation in Infrastructure Database. Octuber 18, 2018 from https://ppi.worldbank.org/en/visualization#sector=&status=&ppi=&investment=&region=&ida=&income=&ppp=PPP&mdb=&year=&excel=false&map=DZ&header=true

Figure 11. Domestic Credit to Private Sector (% of GDP)



Source: Prepared by authors. Retrieved October 18, 2018 from World Bank database https://data.worldbank.org/

4.2. Legal/Legislative Conditions

The legislation under which the project was governed was the code of commerce promulgated by Ordinance No. 75-59 of September 26, 1975, which establishes the law and regulations, as well as the statutes, to be followed by all the shareholders involved.

Other legislation that needed to be considered was the investment code approved by Ordinance No. 01-03, corresponding to August 20, 2001, on the development of the investment. It laid down the regime applicable to national and foreign investments in economic activities for the production of goods and services, as well as investments made in the context of granting consents and/or licenses.

In Algeria, water pricing is fixed by the government. Decree 05-13 of January 9, 2005, determined the rules of utility rates of water supply and sanitation and their related prices.

4.3. Social/Civil Conditions

In the past two decades Algeria reduced its poverty by 20% and reached low values of inequality, evidenced by a Gini index of 27.6 in 2011. The poverty headcount ratio at the national poverty line was 5.5% in 2011, with 0.5% of the population living in extreme poverty (see **Table 4**). However, 10% of the population remained vulnerable to falling back into poverty, threatened mainly by an increasing unemployment rate and potential deterioration of living conditions as a consequence of lower oil prices.

Table 4. Poverty and Inequality Indicators

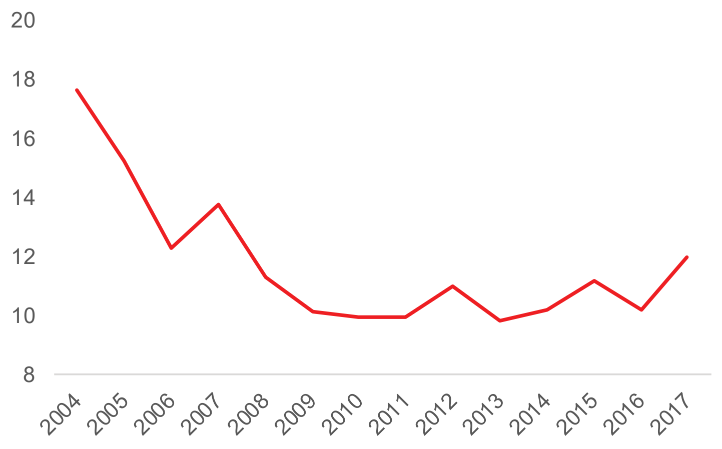
Gini index	27.6
Poverty headcount ratio at national poverty line (% of population)	5.5
Poverty headcount ratio of those living under US$1.90/day (extreme poverty) (% of population)	0.5
Income share held by lowest 10%	4
Income share held by highest 10%	22.9

Note: Last estimations made for 2011.

Source: Prepared by authors. Retrieved October 18, 2018 from World Bank database https://data.worldbank.org/

Regarding unemployment, Algeria achieved a big reduction in the total unemployment rate until 2011, when the trend changed and it started to show an increase (see **Figure 12**). Female unemployment was historically higher, reaching 18% of the total female labor force compared with male unemployment of 8.5% of the male labor force in 2009. These values accounted for 20.6% and 9.8% in 2017, respectively.

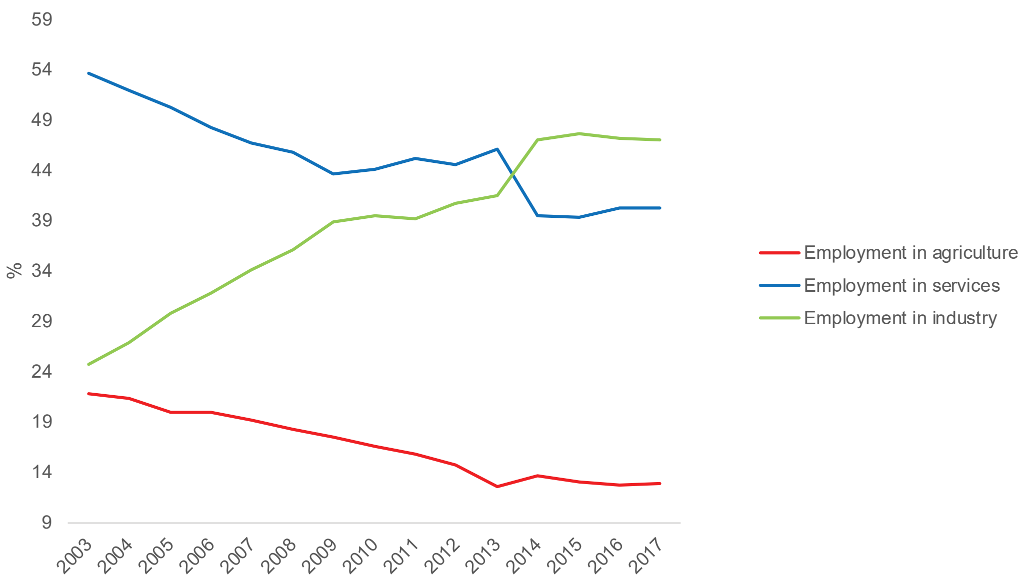
Figure 12. Unemployment Rate (% of Total Labor Force)



Source: Prepared by authors. Retrieved October 18, 2018 from World Bank database https://data.worldbank.org/

Until 2003, Algeria's agriculture sector played an important but declining role, accounting for 22% of the workforce. The industry sector took on an increasing importance in the economy, surpassing the workforce participation of the service sector in 2014, which until 2012 had shown a higher employment rate (see **Figure 13**).

Figure 13. Agriculture, Service and Industry Employment Rate



Source: Prepared by authors. Retrieved October 18, 2018 from World Bank database https://data.worldbank.org/

4.4. Political Conditions

The beginning of the desalination program and the Cap Djinet desalination plant took place under the mandate of Abdelaziz Bouteflika from the National Liberation Front. Bouteflika took the country's presidency in 1999 and, at the date of this publication, has remained in power. The early stage of the program took place in a country recovering from a bloody civil war between the government and various Islamic rebel groups that finished in 2002. President Bouteflika's first mandate was characterized by a strong international participation in what many have called the Algerian return to international affairs. The government interceded primarily in the Africa Union, and among other negotiations, secured a friendship treaty with Spain and negotiated the UE-Algeria association agreement, enhancing the Euro-Mediterranean collaboration.

2008 came with some controversies regarding the constitutional reform that removed the presidential term limit previously included in Article 74, which allowed Bouteflika to run for a third mandate in 2009. These events, along with the sudden rise of staple food prices, led to a series of protests in Algeria between 2010 and 2012, inspired by the Egyptian revolution and other protests in Middle East and North Africa, where the citizens claimed that Algeria was a police state and filled with corruption. Despite this, Bouteflika was reelected in 2014—although with a turnout of 51%—down from 75% in 2009.

4.5. Environmental Conditions

Algeria faced a complex situation in the matter of water resources. According to the United Nations (UN), in 2002 Algeria had a renewable water availability of 364.8 m^3 per capita, per year (see **Table 5**),[13] a value well below the 1,000 m^3 threshold established by the UN. Given that the Sahara Desert covered most of the country, it was not surprising that it was considered a water-scarce nation. However, this situation was aggravated by:

- the interannual droughts faced by the country since the 1980s
- the overexploitation of its natural resources
- its inefficient water supply sector performance

[13] Renewable water corresponds to surface and underground water resources.

Until 2003, some 40% of the drinking water was lost in the distribution system—32% due to technical losses and 8% to illegal connections (World Bank data).[14]

Table 5. Water Resource Indicators

	2002	2007	2012	2014
Total renewable water resource (m^3/capita)	364.8	340.6	311.7	294.2
Total renewable water resources (billion m^3/year)	11.67	11.67	11.67	11.67
Total freshwater withdrawal (primary and secondary) (billion m^3/year)	5.706		7.81	

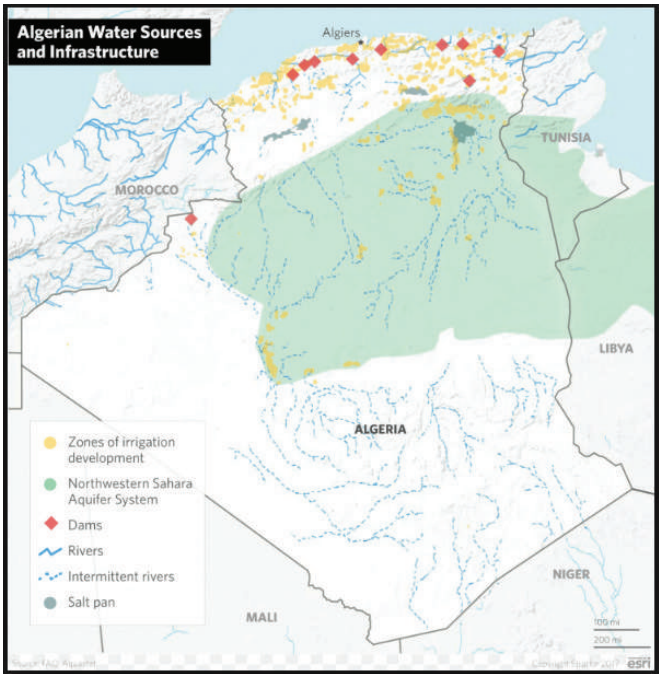
Source: Food and Agriculture Organization (FAO) of the UN and Aquastat.

In addition, the water resources are unevenly distributed. Most of the surface water resources (rivers and lakes) are concentrated in the country's northern region, whereas much of the groundwater is located primarily in the sparsely populated central and southern areas (see **Figure 14**). Many of these water sources are not without consumption risks, given that not only are they very slow to replenish, but also some of the water drawn from them is called fossil water, because it has sat undisturbed in the aquifers for millennia.[15]

The renewable water resources are also facing signs of decline. Algeria's population and urbanization growth has pushed the withdrawal of these resources, a withdrawal which has continuously increased over time, reaching 67% of the country's renewable water resources in 2012.

This is why the authorities deployed the desalination program to supply water to the increasing population. However, the high production costs of this program implied a heavy investment, which represented a constraint in the difficult economic situation faced by the country. As a result, PPPs are vital in assuring and improving access to water throughout the whole country.

Figure 14. Algerian Water Resources and Infrastructure



Source: FAO and Aquastat. Retrieved from Stratfor (2016). Algeria: a Desert Nation Fighting to Maintain Water Supplies. Retrieved from https://worldview.stratfor.com/article/algeria-desert-nation-fighting-maintain-water-supplies

[14] World Bank (2004). Seawater and brackish water desalination in the Middle East, North Africa and Central Asia: A review of key issues and experience in six countries (Vol. 2): Annex 1- Algeria (English).

[15] Stratfor Assessments.

5. Impact of the Project

The project primarily affected the following agents.

5.1. Administration

The provision of drinking water was one of the most important services that the Administration had to provide. In Algeria, the continuous droughts, decreasing renewable water resources and the inefficiency in the water supply led the government and public administration to deploy the water desalination program in which the Cap Djinet plant participated.

Through this PPP, the administration took advantage of the technology, experience, investments and market efficiency that the private sector provided, offsetting the water losses of previous desalination plants—managed with a lack of expertise, according to the World Bank. The water productivity indicator—often used as an approximation of the efficiency by which each country uses their water resources—in Algeria went from US$19.9 of GDP per cubic meter of water withdrawn in 2001 to US$21.9 in 2012, according to the data available from the World Bank.

The administration also benefited from the partial transfer of the financial risk to the private sector and the decrease of costs due to the presence of experienced operators to manage the service. The PPP also allowed the public sector to finance new, expensive water infrastructure to cover the urgent need for water that the country faced—especially after the tough economic situation that Algeria experienced with the drop in oil prices and the reduction of fiscal income to finance these projects. This way, the financial framework of the project limited the pressure on public finances during the construction years. The administration also benefited from the shared revenues derived from 49% of the shareholding of the plant.

Finally, by providing new infrastructure and supplying water to the population, the administration gained legitimacy, which could have been jeopardized after the scandals and riots that exploded in 2009 and 2010.

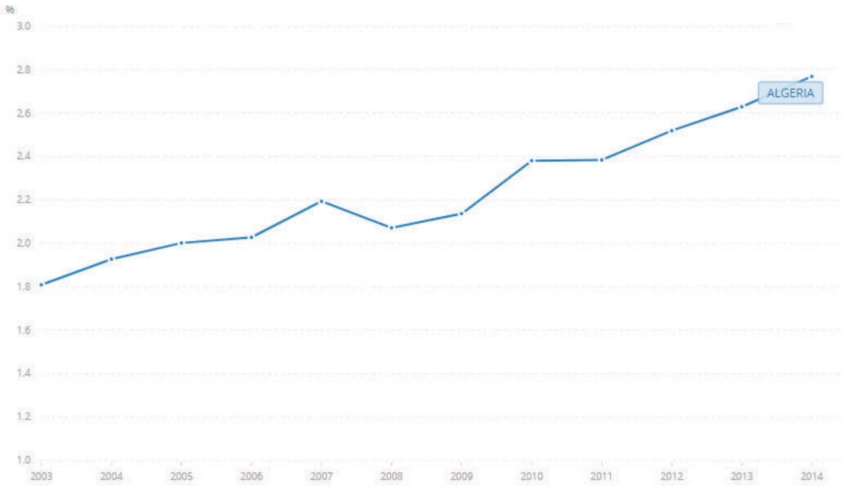
5.2. Residents

The benefits for Algerian residents were straightforward. With the increase in drinking water that skyrocketed after the completion of the plant (and other desalination plants), the residents had access to a higher amount of this scarce and vital resource. According to the UN, the desalinated water produced jumped from 17 million m^3 per year to 615 million m^3 in 2012, when the testing period of the plant started.[16] Also, the percentage of people using at least basic drinking water services went from 89.84% of the population in 2000 to 93.46% in 2015.

The new water produced also helped the agriculture industry, which was one of the sectors most affected by the deprivation of water and which sometimes had to resort to illegal drilling to obtain water for irrigation. The new water supplied by desalination may have helped change this reality, as the country saw a big increase in the percentage of irrigated land from 2009, as depicted in **Figure 15**.

[16] There were no data available for latter years by the time of the development of this study.

Figure 15. Agricultural Irrigated Land (% of Total Agricultural Land)



Source: World Bank database. Retrieved October 18, 2018 from https://data.worldbank.org/indicator/AG.LND.IRIG.AG.ZS?locations=DZ&view=chart

The residents also benefited from the new jobs generated by the construction of the plant. According to the data provided by Aqualia, an average of 100 jobs were created during the EPC phase; 20 of these were nonlocal workers who occupied qualified positions, and the remaining average of 80 were local workers in nonqualified positions. In the O&M stage, 44 positions were created (40 local workers and four expatriates). Finally, four local workers were hired for both the EPC and O&M stages.

5.3. Environment

Although desalination was considered to be a nonconventional water resource and a high-energy consumption process, the administration tried to reduce environmental impacts to a minimum by making the RO desalination process a condition when awarding the contract. According to the academic literature, RO consumed the least energy of all the different desalination procedures (Fritzmann et al., 2007), which is why it gained acceptance by countries around the globe and had become the leading water desalination procedure by the end of the 2010s (Wenten and Khoiruddin, 2016).[17]

The availability of new water for the population and for local farmers also had a positive externality on the use of alternative water resources. The higher supply of desalinated water freed up water from the reservoirs that were being increasingly exploited and were not able to replenish water at the same rate as it was withdrawn. It also prevented the increment of the illegal drilling of the wells and the resulting damage on the environment.

5.4. Awarded Companies

The awarded companies benefited from the participation in a massive desalination program deployed by the Algerian government. The Cap Djinet plant was the second plant in the country awarded to Aqualia and INIMA, the first being the desalination plant in Mostaganem. This second plant consolidated INIMA and Aqualia as two of the leading water infrastructure and management firms in the field. It also promoted the use of PPP networks for future projects and the pivotal role of private participation in driving these projects forward.

They also derived benefits from the PPP contract, as they not only obtained revenues from the EPC and O&M contracts but also from the shareholding derived from the equity investment in the joint venture with AEC. The firms were facilitated with a more efficient resolution in administrative affairs due to their relationship with a state-owned company.

[17] I.G. Wenten and Khoiruddin, "Reverse Osmosis Applications: Prospect and Challenges," *Desalination* 391 (2016): 112–125.

6. Assessments

6.1. PPP Methodology

This case clearly illustrates some of the characteristics of PPPs' contributions to social welfare. It is about a clearly bundled PPP project (covering the design, construction, operation and maintenance of a large desalination plant in Algeria), where scale and international experience were crucial, along with the presence in the SPV of a state-owned partner that facilitated commitment. In developing countries without a strong institutional framework to support private sector investment, the participation of public sector partners is a second-best solution to convince private investors that their contribution to long-lived assets will not be expropriated.

The case shows the importance of commitment for long-lived investments in sunk assets. It is a very clear example of the need (in terms of efficiency) for large infrastructures. Since infrastructures with large fixed and sunk costs are needed, private investors will participate only if they perceive a credible commitment that they will recover any investment they make.

The geographical and historical background of this project plays an important role, with a very clearly unbalanced spatial distribution of water in Algeria. This made public intervention absolutely necessary in terms of planning and investment. In this case, public planning was learned from experience—from the failure of small-scale desalination plants to the need to increase scale and tap into the international experience of foreign multinationals. There was a learning process by the Algerian authorities, which was crucial as a substitute for a cost-benefit analysis (CBA) that, in the case of projects with little experience in the country, was very difficult to undertake.

There was a clear bidding process and the different stages and timeline of the project. In the bidding process there were two stages, a technical one, where initial bidders were screened, and a commercial one where the winner was the bidder that offered the lowest price of the goods that would be provided. In this case, there were four bidders in the second stage, and the winner was a coalition of two multinationals with experience in the construction of large-scale water projects and desalination plants. It is unclear, however, how the price proposed by the winning bidder affected the regular cash flows that remunerate the investment over the lifetime of the project (EPC + 25 years of O&M).

The winning bidder then participated in the SPV of the project, together with Algerian public sector operators, where the public sector had 49% of ownership and the private operators 51%. In this way, the inflation, exchange rate and demand risk were totally allocated to the public sector operators; the other risks being shared with the state-owned operators that participated in the SPV.

The case also illustrates the importance of (to the extent that it is possible) managing political factors in PPP projects. The beginning of the desalination program and the Cap Djinet Seawater Desalination Plant took place under the mandate of Abdelaziz Bouteflika. As the case explains, his first mandate was characterized by what many have called the Algerian return to international affairs, interceding mainly in the African Union, and among other negotiations, securing a friendship treaty with Spain and the UE-Algeria association agreement, enhancing the Euro-Mediterranean collaboration. This fact gave the project a context of openness and international cooperation.

The governance mechanisms established by the PPP contract itself were relatively weak, as the contract only considered the appeal to arbitrators and experts in case of disputes among the parties. There was apparently no regular mechanism for monitoring and enforcing the contract terms. This is, of course, replaced by the presence of the public sector in the SPV, and also as a client (purchasing the water) and as a financier, since the lending (where debt was 80% of the financing) was provided by state-owned banks.

The life of the project, at least through the 2010s, survived general political controversies explained in the case, which along with the sudden rise of staple food prices led to a series of protests in Algeria between 2010 and 2012. There was political unrest inspired by the Egyptian revolution and other protests in the Middle East and North Africa. Despite this, Bouteflika was reelected in 2014, although with a turnout of 51%—down from 75% in 2009. Future events could test the resilience of the project to a conflictual political system.

The PPP methodology used in the project is summarized in **Table 6**.

Table 6. PPP Methodology

Cap Djinet Seawater Desalination Plant			
	PPP Methodology	Existing	Details
1. Procurement method & bidding process			
1.1	Value-for-money analysis or cost-benefit analysis	No	
1.2	Real competition for the contract	Yes	4 bidders
1.3	Tender evaluation committee	No	Evaluated by the public authority
2. Contractual issues & incentives			
2.1	Bundling	Yes	DBFOMT
2.2	Quality verifiable	Yes	Minimum required quality by contract conditions
2.3	Externalities	Yes	Positives
2.4	Duration		EPC + 25 years of O&M
3. Risk, finance & payments			
3.1	Construction & operation risk	Transferred	
3.2	Demand risk	Not transferred	
3.3	Policy & macroeconomic risk	Partially transferred	
3.4	Payment mechanism	Capacity + Volume-based variable remuneration + (possible) extra capacity remuneration	
3.5	Special Purpose Vehicle (SPV)	Yes	Aqualia-INIMA (51%) and AEC (49%)
4. Governance			
4.1	Transparency	Not observed	There is not enough public information to enable the transparency in the governance of the contract to be looked at.
4.2	Participatory decision-making process	Not observed	There is not enough public information to enable the decision-making process in the project to be looked at
4.3	External monitoring	Yes	Arbitration or expert designation in the case that the controversy is not solved amicably
4.4	Legal framework	Yes	Conciliation and arbitration Rules of the International Chamber of Commerce (ICC)
5. Construction process			
5.1	Cost overrun	No	
5.2	Delayed deadlines	Yes	Delay in the SPV contract signature
6. Potential benefits			
6.1	Possible price certainty	Yes	If contract enforced
6.2	Transfer of responsibilities to private	Partially	If contract enforced
6.3	Scope & incentives for innovation	Yes	Environmental impact minimization technology & additional capacity remuneration
6.4	Savings in public payments	Yes	Ease on the fiscal pressures in the short run due to the financial framework of the contract
6.5	Life-cycle approach	Yes	The awarded firms are currently operating and maintaining after the EPC stage
6.6	Incentive to finish on time	Yes	If contract enforced

Source: Prepared by the authors.

6.2. UN Sustainable Development Goals

With regard to how the Cap Djinet Seawater Desalination Plant helped reach the UN Sustainable Development Goals (SDGs), we can identify two levels of impact: a high impact and a moderate one (see **Table 7**).

In terms of high impact, the PPP analyzed reached, of course, Goal 17 (partnerships), as the basic foundation of a PPP is the agreement between the private and the public sector. Beside this goal, Goals 6 (clean water), 13 (climate action), 14 (life below water) and 15 (life on land) seemed also to receive a high impact, thanks to the seawater desalination plant. The reason can be found in Sections 7.2 and 7.3, where it is proven that the plant reduced the exploitation of reservoirs and increased the availability of the water supply for irrigation. Therefore, the pressure on the environment was reduced.

In addition, the seawater desalination plant also had a moderate impact on other SDGs, such as Goals 2 (zero hunger), 3 (good health), 8 (work), 9 (industry), 10 (reducing inequalities) and 11 (sustainable cities). In terms of the last one, Goal 11, the positive impact was related to the fact that solving a problem of scarcity of water supply without exploiting resources meant that the urban environment was more sustainable. From this remark, we can see that guaranteeing a sustainable water supply had health benefits, thanks to the fact that drinkable water was of better quality, but also because this increase of water supply improved the agriculture sector (see Section 7.2) and, therefore, it seems it made it possible to increase the availability of food. This fact brings us to the point that it seemed to have at least a moderate impact on Goal 2.

Finally, the construction and operation of the seawater plant brought more jobs and led to growth in the region's water industry. More jobs and a larger industry was a guarantee, together with reduction of hunger and an increase of work, of a reduction in inequalities. Therefore, it seems it is also reached Goals 8, 9 and 10.

Table 7. United Nations Sustainable Development Goals

		Cap Djinet Seawater Desalination Plant	
	Sustainable Development Goals	High Impact	Moderate impact
1	No poverty		
2	Zero hunger		✓
3	Good health & well-being		✓
4	Quality education		
5	Gender equality		
6	Clean water & sanitation	✓	
7	Affordable & clean energy		
8	Decent work & economic growth		✓
9	Industry innovation & infrastructure		✓
10	Reduced inequalities		✓
11	Sustainable cities & communities		✓
12	Responsible consumption & production		
13	Climate action	✓	
14	Life below water	✓	
15	Life on land	✓	
16	Peace, justice & strong institutions		
17	Partnership for the goals	✓	

Source: Prepared by the authors.

6.3. City Strategy

This case study constitutes an important contribution from the PPP viewpoint and also from its contribution to the SDGs. However, there is no specific, independent relationship with cities and their plans, so it is more difficult to evaluate this dimension, despite the plant's contribution of water to cities and the resulting increase in the population.

7. Conclusions

This project represents a good example of public–private collaboration to respond to the urgent requirement of an essential resource such as water. Even though water desalination can be considered as a nonconventional drinking-water source, the uneven distribution of water resources in the country and the continuous droughts that it faced pushed the authorities to take action.

The intervention of the public authorities as part of the SPV to facilitate the development of the project, plus their commitment throughout the life cycle of the partnership to guarantee the return of private sector investment, represent a good example to attract private investment to developing economies where a weak institutional framework imperils them from attracting investment. The former is particularly important in the context of the project, given that the investment deployed represents 0.07% of Algeria's GDP in 2014 and, as such, has a significant potential impact on the national economy's production.

The historical and geographical background were important to the public authorities' planning. Although lacking a proper CBA, which is part of the good practice of a successful PPP—especially given the high costs that large-scale water desalination plants represent—we see the studies carried out to define the water desalination strategy as a good alternative to compensate for it. Past failed experiences in water infrastructures and the increasing stress on water supply can justify to a large extent the employment of desalination plants. Carrying out appropriate monitoring of the water delivered and natural water resources withdrawal is encouraged to prevent future water losses and vindicate the importance of this and other water desalination infrastructures, as well as the implementation of PPP schemes to guarantee their efficient operation.

With regard to the PPP, this case study displayed three prototypical features of a successful PPP:

1. First, its design was based on several stages, starting with the importance of the infrastructure to satisfy urgent needs of the population and the correct bundling of several tasks (design, construction, operation and maintenance) that were complementary.

2. Second, a clear bidding process to select an experienced international operator with the know-how to undertake the project at the lowest possible cost.

3. Third, the careful management of commitment problems through cooperation with public sector organizations.

Regarding the governance mechanisms established in this PPP, we still need to verify their correct monitoring and enforcement of the contract terms in practice. As of the date of the writing of this report, the project setbacks were still in the process of a friendly solution between both parties, causing delays that might have ended up in direct (financial) and indirect (time delay) cost overruns in the construction of the plant. Still, the remarkable flexibility shown by both parties allowed the correct operability of the infrastructure, which prevented them from jeopardizing the needs of the final consumers.

Regardless of these setbacks, the benefits for the stakeholders of the project were plausible, especially regarding the capacity of the administration and the awarded companies to attend the urgent needs of the population for this vital liquid in a country where the environmental and geographical conditions play against its availability and even distribution. The project also showed the capacity to survive general political controversies—a merit for the administration and the private investors. This showed the importance of the commitment of both parties throughout the lifetime of the project, which still faces a conflictual political system that will likely test its resilience in the future.

In light of the tangible evidence of the project to the attainment of the SDGs, and the correct operability of it, despite its drawbacks, we can consider this project as a successful PPP.

Exhibit 1

Economic Impact

In this exhibit, we estimate the expected macroeconomic impact of the investment deployed for the Cap Djinet Seawater Desalination Plant upon the output of the Algerian economy. This analysis focuses on the output (sales) generated in the short term for the project, considering the initial investment employed for the construction of the plant. To do so, we employ input-output (IO) methodology.

The IO model is based on input-output matrices constructed from observed economic data for a specific geographic region (metropolitan area, state, country, etc.). The matrices depict the activity of a group of industries that both produce goods (outputs) and consume goods from other industries (inputs) in the process of producing each industry's own output (Miller and Blair, 2009); allowing for an inter-sectorial assessment of the economy. From the IO matrix, we can calculate the final demand multipliers in terms of output. These multipliers express the linkage degree between industries and allow us to quantify the total effect that a specific industry has on the economy, which is why it has been commonly used to quantify the economic impact of an increase in the final demand of a given industry.

The multipliers capture two effects of a change in the economic activity: direct and indirect effects. The idea behind this is that an initial increase in the final demand of a given industry will multiply the demand of that industry (direct effect) and those linked industries (indirect effect). As an example, the initial investment in water infrastructure will affect the final demand of the construction sector, which would lead to the increased production of concrete, which results in more production in mining.

Here, we have calculated these multipliers using the 2014 IO national table published by the Algerian Office of National Statistics (ONS) (http://www.ons.dz/) and obtained the expected output impact coming from the investment in the plant. The results are shown in **Table 8**.

Table 8. Summary of Economic Data

GDP (Algeria, 2014)	14,489,710 million Algerian dinars	US$179,819.89 million
Investment in the Cap Djinet Seawater Desalination Plant	11,122.31 million Algerian dinars	US$138.03 million
Estimated output impact of the project	12,412.34 million Algerian dinars	US$154.04 million
Generated output relative to national GDP	0.09%	
Direct jobs generated from the project	100 jobs in the EPC stage + 44 in O&M	

Note: The investment in US$ presented in this case study has been converted to the local currency using the 2014 official average exchange rate reported by the World Bank (80.57 Algerian dinars per US$1) in order to homogenize it with the IO matrix from the official statistics.

Source: Prepared by the authors.

The study estimates that the 11,122.31 million Algerian dinars (US$138 million) invested in the project helped increase the total production in the Algerian economy through direct and indirect effects by 12,412 million Algerian dinars (US$154 million), which represented 0.09% of the national GDP in 2014. This way, 1 Algerian dinar invested in the construction increased national production by 1.12 Algerian dinars. The construction and operation of the plant directly generated 144 jobs. The impact in relative terms on the GDP can be considered to be representative, given the high investment in this project (which represented 0.07% of the national GDP).

It is important to address the fact that the IO methodology needs to comply with some assumptions that can limit the final interpretation of the results. Additionally, the use of national macroeconomic data makes the results inaccurate if they are to be used for a deeper understanding of the impact on the regional economy (such as at the state or city level). In spite of these constraints, the methodology can be used as a good approximation at the national level, although we recommend that the reader interprets the results with precaution.

Exhibit 2
Timeline

2004
Tender invitation for investors.

2005
Bid delivery and opening, and contract adjudication.

2006
Association contract signature between Aqualia, INIMA and AEC (public partner).

2007
Signature of the water purchase and EPC contract.

2008
Financing agreement.

2012
Provisional delivery of the plant and start of the testing period.

2014
Final delivery of the plant and start of the O&M stage.

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Camino del Cerro
del Águila, 3
28023 Madrid, Spain
(+34) 91 211 30 00

New York
165 W. 57th Street
New York,
NY 10019-2201 USA
(+1) 646 346 8850

Munich
Maria-Theresia-Straße 15
81675 Munich, Germany
(+49) 89 24 20 97 90

Sao Paulo
Rua Martiniano de
Carvalho, 573
Bela Vista
01321001 Sao Paulo, Brazil
(+55) 11 3177 8221