



# Desalination powered Renewable Energies: Opportunities for Algeria



**Virtual Event**

**Desalination Using Renewable Energy**

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- ▶ Water challenges in Algeria
- ▶ Desalination in Algeria
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- ▶ Industry in Algeria.
- ▶ RE in Algeria
  - ▶ Implemented projects
  - ▶ Case studies
  - ▶ Feasibility study of grid-connected photovoltaic system for seawater desalination plant in Algeria (case of Maqtaa)
  - ▶ Pilot scale reverse osmosis desalination at the village of Hassi-khebi

# Water challenges in Algeria

- ▶ Growing demand driven by population growth and rural-to-urban migration.
- ▶ Little rainfall; affecting the water reservoirs.
- ▶ Uneven spatial distribution of water resources
- ▶ The effects of climate change on precipitation patterns which led continuous droughts.
- ▶ up to 30 per cent of water is lost in transit.
- ▶ Relying on seawater Desalination and wastewater reuse became a necessity.

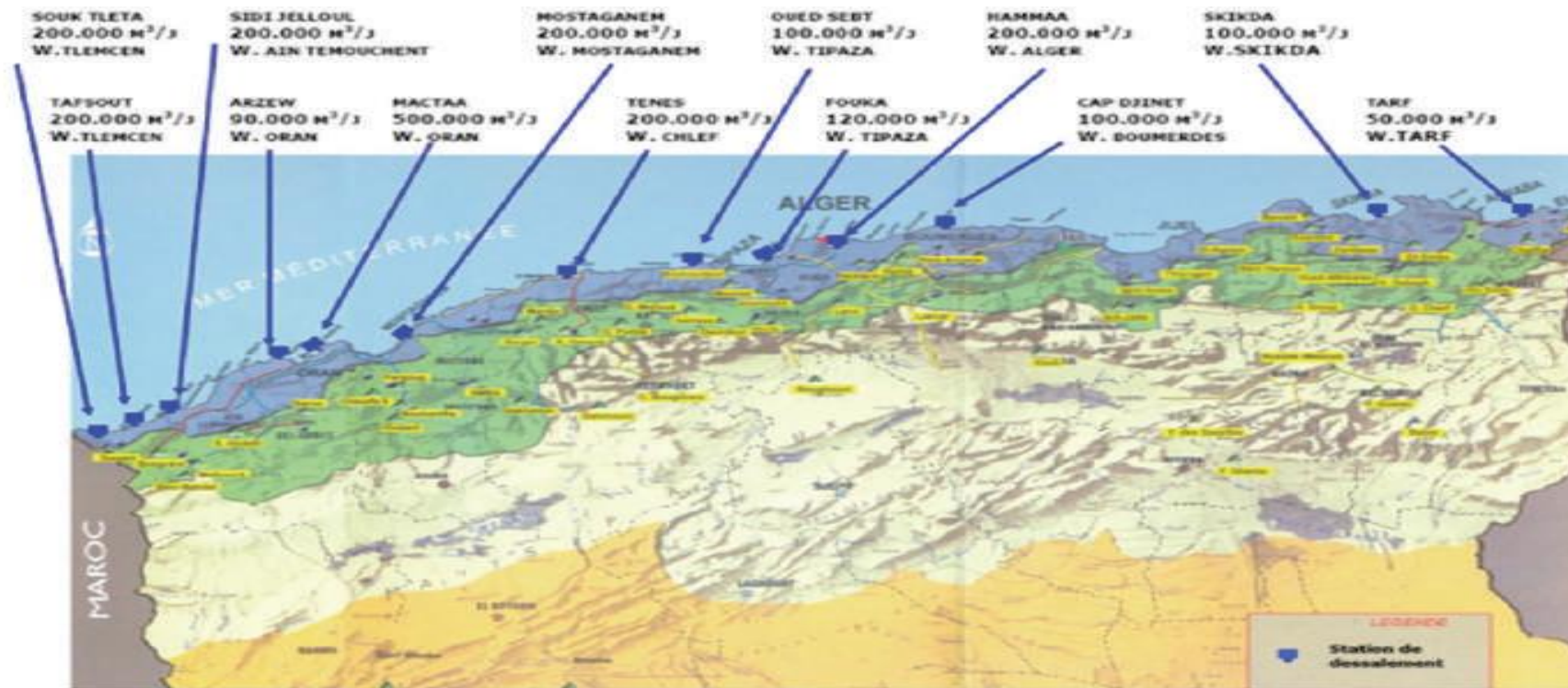


Figure 1. Water desalination plants location

**Algerian Desalination capacity : around 2.2 millions m<sup>3</sup>/day  
(aec.dz)**

# Large scale desalination plants

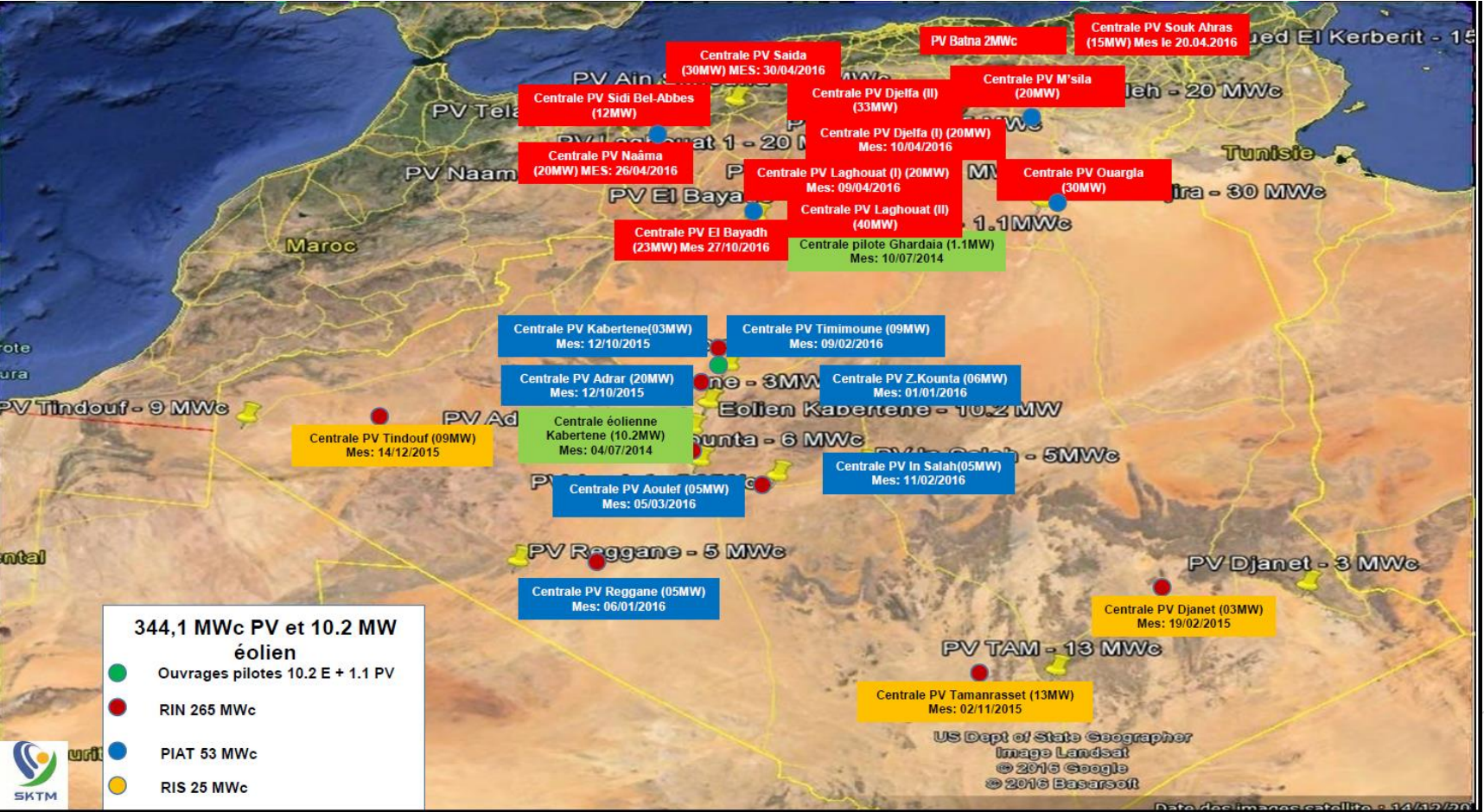
Location	Capacity (m <sup>3</sup> /d)	Commissioning	Partners
Kahrana	86.680	Since 2006	J.Burrow Ltd : 05%
Hamma	200.000	Since 2008	GE Ionics "USA" : 70%
Skikda	100.000	Since 2009	Geida (Befesa/Sadyt) "Spain" : 51%
Beni Saf	200.000	Since 2010	Cobra/Spain" : 51%
Souk Tlata	200.000	Since 2011	TDIC (Hyflux/Malakoff) "Singapore" : 51%
Fouka	120.000	Since 2011	AWI (Snc Lavalin/Acciona) : 51%
Mostaganem	200.000	Since 2011	Inima / Aqualia "Spain" : 51%
Honaine	200.000	Since 2012	Geida (Befesa/Sadyt) "Spain" : 51%
Cap Djinet	100.000	Since 2012	Inima / Aqualia "Spain" : 51%
Ténes	200.000	Since 2012	Befesa "Espagne" : 51%
magtaa	500.000	Since 2015	Hyflux "Singapore" : 47%, ADE "10%
<b>Total</b>	<b>2.106.680</b>		

providing drinking water daily to 5 million people.

# Carbon Foot Print Assesement of Desalination

- ▶ Desalination plants CO<sub>2</sub> emissions:
  - ▶ Around 500.000 tons CO<sub>2</sub>/year (Mohammedi, 2014)
  - ▶ Comparison with Australia: 1,193 kt CO<sub>2</sub>e (Heihselet al., 2019)
- 
- ▶ Algeria is committed to reduce its GHG by 7%

# Status of renewable energy projects implemented in Algeria



Source: SKTM

# Total installed capacity of renewable energy in Algeria

Centrales	P. Inst (MW)	Production (GWh)
		à juin 2017
<b>3- Réseau RIN</b>		
Oued Nechou PV (Ghardaia)	1,1	4,593
Sedret Leghzel (Naâma)	20	40,715
Oued El kebrit (Souk Ahras)	15	28,900
Ain Skhouna (Saida)	30	14,213
Ain El Bel (Djelfa) 1 et 2	53	25,134
Lekhneg (Laghouat) 1 et 2	60	53,576
Telagh (Sidi-Bel-Abbes)	12	7,417
Labioudh Sidi Chikh (El-Bayadh)	23	19,146
El Hdjira (Ouargla)	30	9,738
Ain-El-Melh (M'Sila)	20	16,473
Oued El Ma (Batna)	02	-
<b>Total SKTM (EnR)</b>	<b>354,3</b>	<b>470,318</b>

Source: <https://www.sktm.dz/?page=article&id=56>



# Feasibility study of grid-connected photovoltaic system for seawater desalination plant in Algeria (case of Maqtaa)

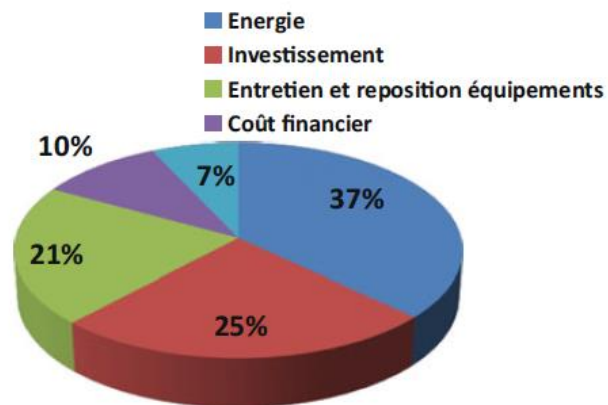
## Data sheet of Tahlyiat Miyah Maqtaa Desalination Plant

Location	District Marsat El Hadjadj common Magtaa, Oran
Project owner	Tahlyat Myah Magtaa stock company
Constructor	Hyflux (singapore)
Operator	Hyflux OMA
Treatment process	Reverse osmosis with energy exchanger
Production capacity	500,000 m <sup>3</sup> /d
Power consumption	3.2 kWh/m <sup>3</sup>
Amount of project	492 M\$
Component of the station	25 modules of 21,000 m <sup>3</sup> /d unit production, 24 modules in production, and 1 on standly 288 units PX energy interchanges
Quality of the water produced	Complies to the OMS standards
Start of operation	Commissioned in 2015
The associated	Hyflux: Singaporean company 49%. AEC: Algerian Energy Company 51%
Customer	Contract of sale and purchase of water: TMM - Sonatrach - SIOR (jointly)

# Estimation of the Cost of Water with the PV Generator versus the use of electricity based fossil fuel

Decomposition of the production cost per item of expenditure.

- ▶ The contractual price of m<sup>3</sup> of water of the project with the connection to the grid of Sonelgaz is 45 DA/m<sup>3</sup> (**0,43€/m<sup>3</sup>**).



The new cost of m<sup>3</sup> is estimated at 374 DA.

Global investment (€ 3887 million) € 368 million (initial investment) + 25 x 140.76 M€ (photovoltaic investment)		
Estimated cost per m <sup>3</sup> of freshwater €/m <sup>3</sup>		
Investment 7,774 €/m <sup>3</sup> /d 20 years at 5% 95% of availability	$(7,774 \times 0.08) / (365 \times 0.95) = 1.79 \text{ €/m}^3$	51.07%
Electric power	0 €/m <sup>3</sup>	0%
Operating and maintenance 5% of the investment	$7,774 \times 0.05 / (365 \times 0.95) = 1.12 \text{ €/m}^3$	31.95%
Personal cost	0.245 €/m <sup>3</sup>	7%
<b>Total cost</b>	<b>3.505 €/m<sup>3</sup></b>	<b>100%</b>

# Pilot scale reverse osmosis desalination at the village of Hassi-khebi

## Site characteristics:

- ▶ latitude: 29°11', longitude: 5°21' west
- ▶ raw water: brackish, salinity: 3.5 g/l
- ▶ solar radiation: 6071 Wh/d minimum, 7510 Wh/d maximum
- ▶ number of inhabitants: about 800

## Experimental installation and testing:

- ▶ Reverse osmosis unit
- ▶ Photovoltaic generator
- ▶ Energy storage and regulation system
- ▶ Raw and fresh water storage system



RO unit

This installation produces nearly 1000 I/h of fresh water from underground brackish water.



Photovoltaic generator

**Unit of Hassi Khebi with reverse osmosis associated with a PV generator.**



# Concluding remarks

- Desalination is an energy-intensive technology. When powered by fossil fuel, high carbon emissions ensue.
- Economic requirements and population growth are the drivers of desalination and carbon emission in the first place.
- Substitution of fossil energies by renewable energies can thus be the game changer for the sustainability of desalination. Especially regions affected by climate change.
- Policy must act and focus on the energy sector. The key is the transformation of the electricity sector and the change in the current energy mix with a drastic increase in the share of renewable energies.