SYCHEM
ADVANCED WATER TECHNOLOGIES

GROUP OF COMPANIES

Company Profile

Athens, 2016

Who we are

Pioneer & market leader

- The biggest Greek manufacturer of demanding water **desalination** plants with significant size in private sector projects (Oil Refineries, Power Plants, hotels, industry, municipal etc)
- Sychem Group is the biggest manufacturer of open loop **geoexchange** energy projects in Greece with focus on the sea water energy exploitation
- The biggest private **producer of water** in Greece
- Major international provider of **cathodic protection** equipment and anodes
- **Sustainable growth**, reaching €28 M forecasted in 2016
- HQ in **Athens** and industrial facilities and offices in **Crete**, **Cyprus** and **China**

SYCHEM
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SYCHEM - Industrial facilities

Crete, Greece

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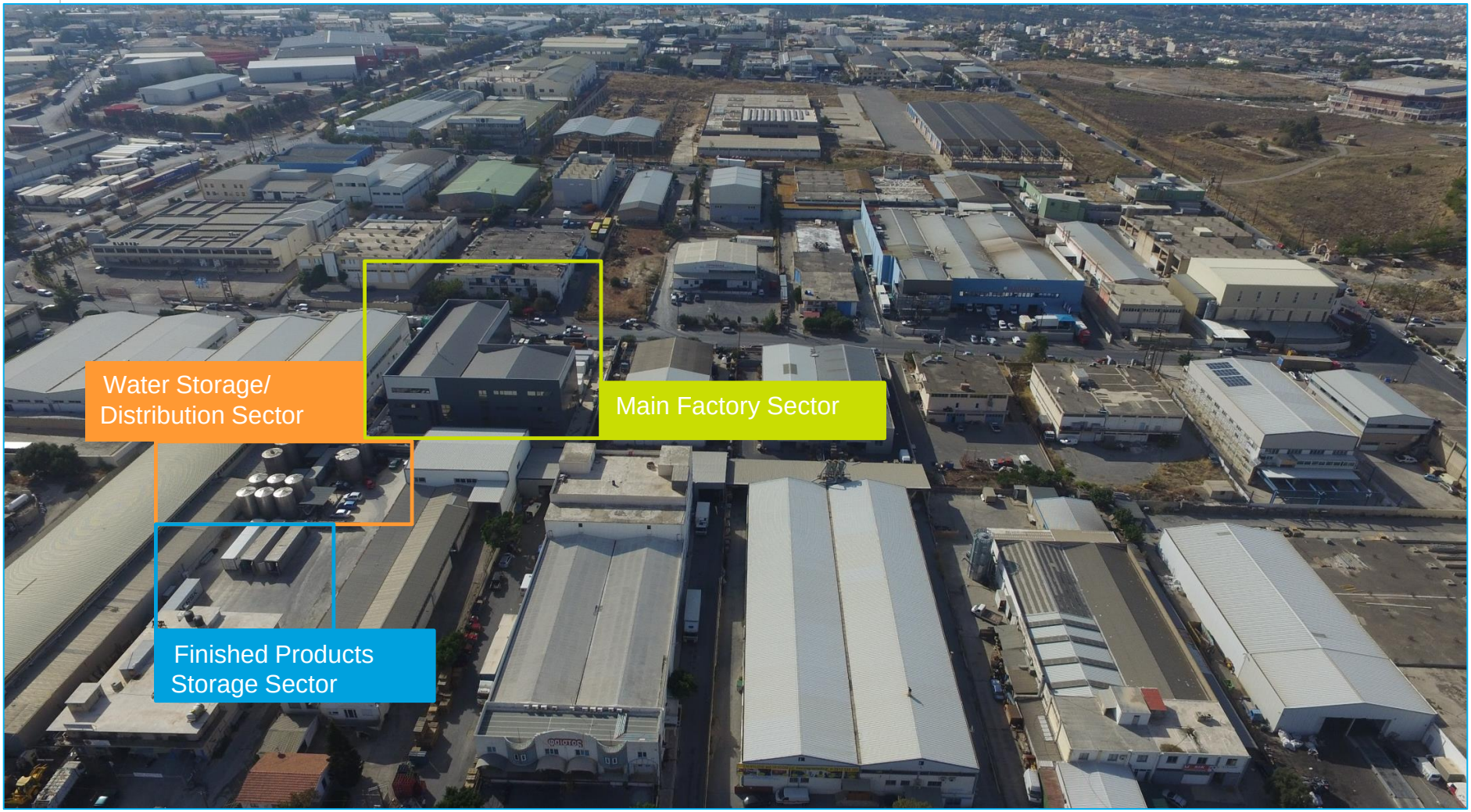
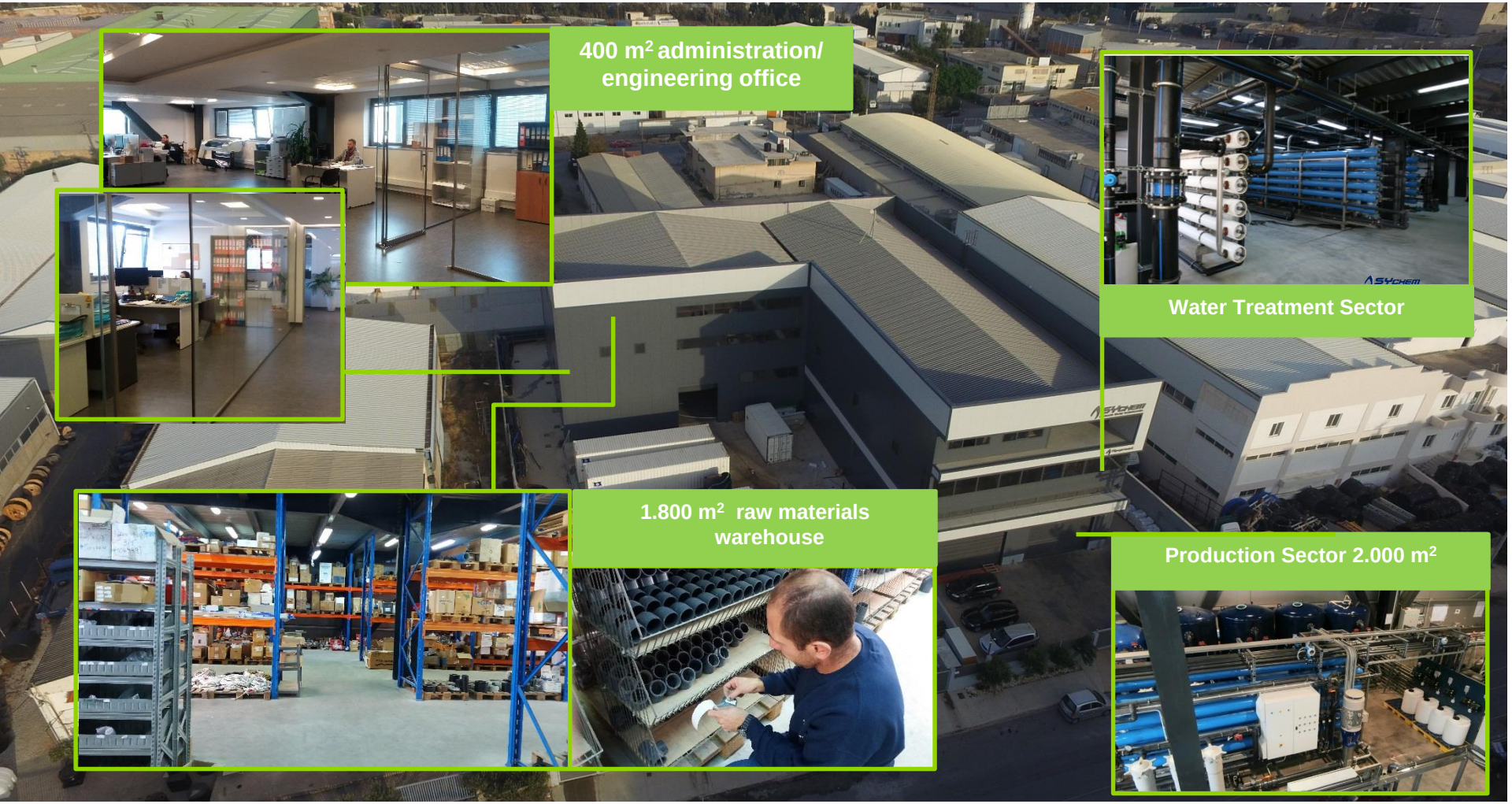
SYCHEM - Industrial facilities

Crete, Greece

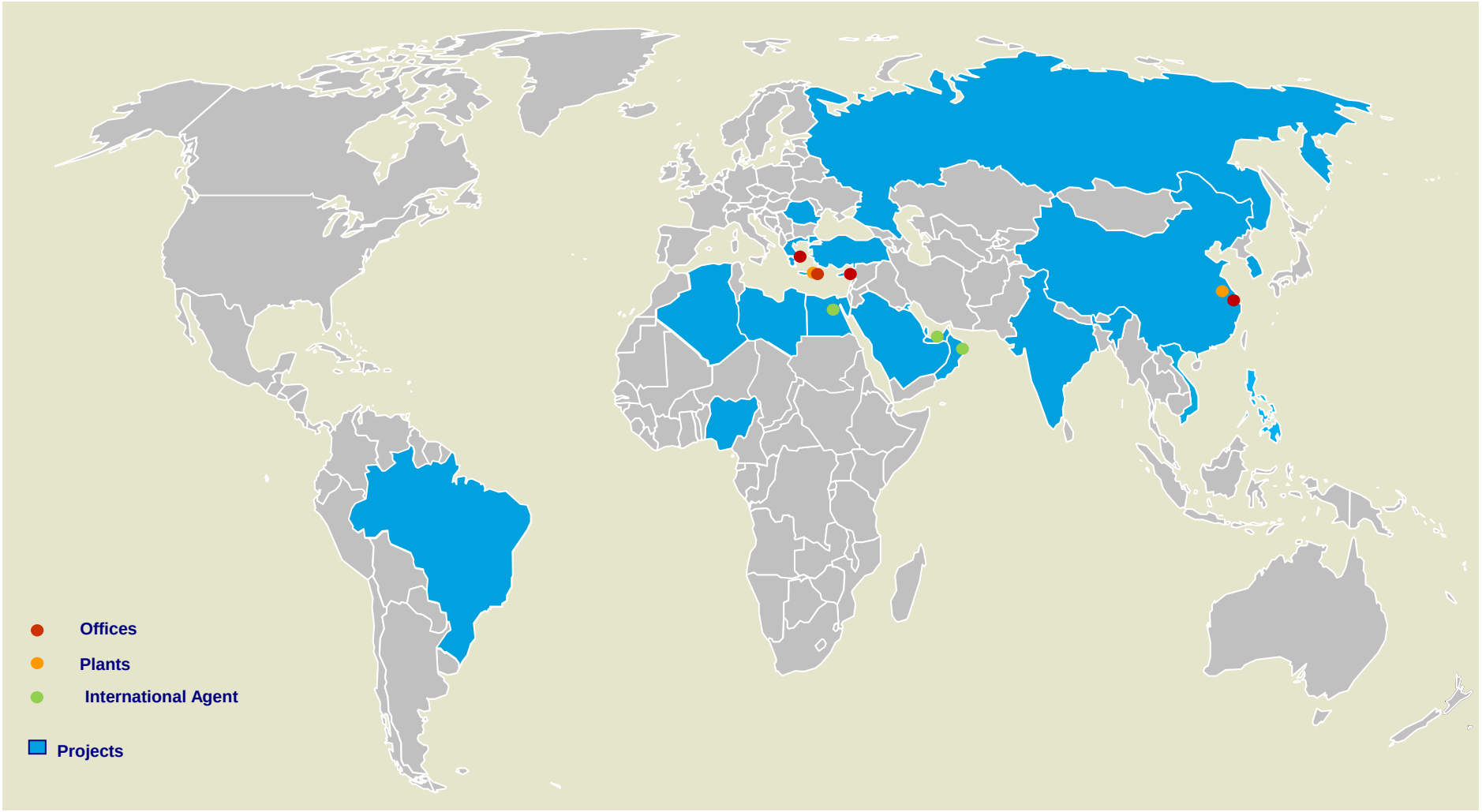


SYCHEM - Industrial facilities

Crete, Greece



International market presence



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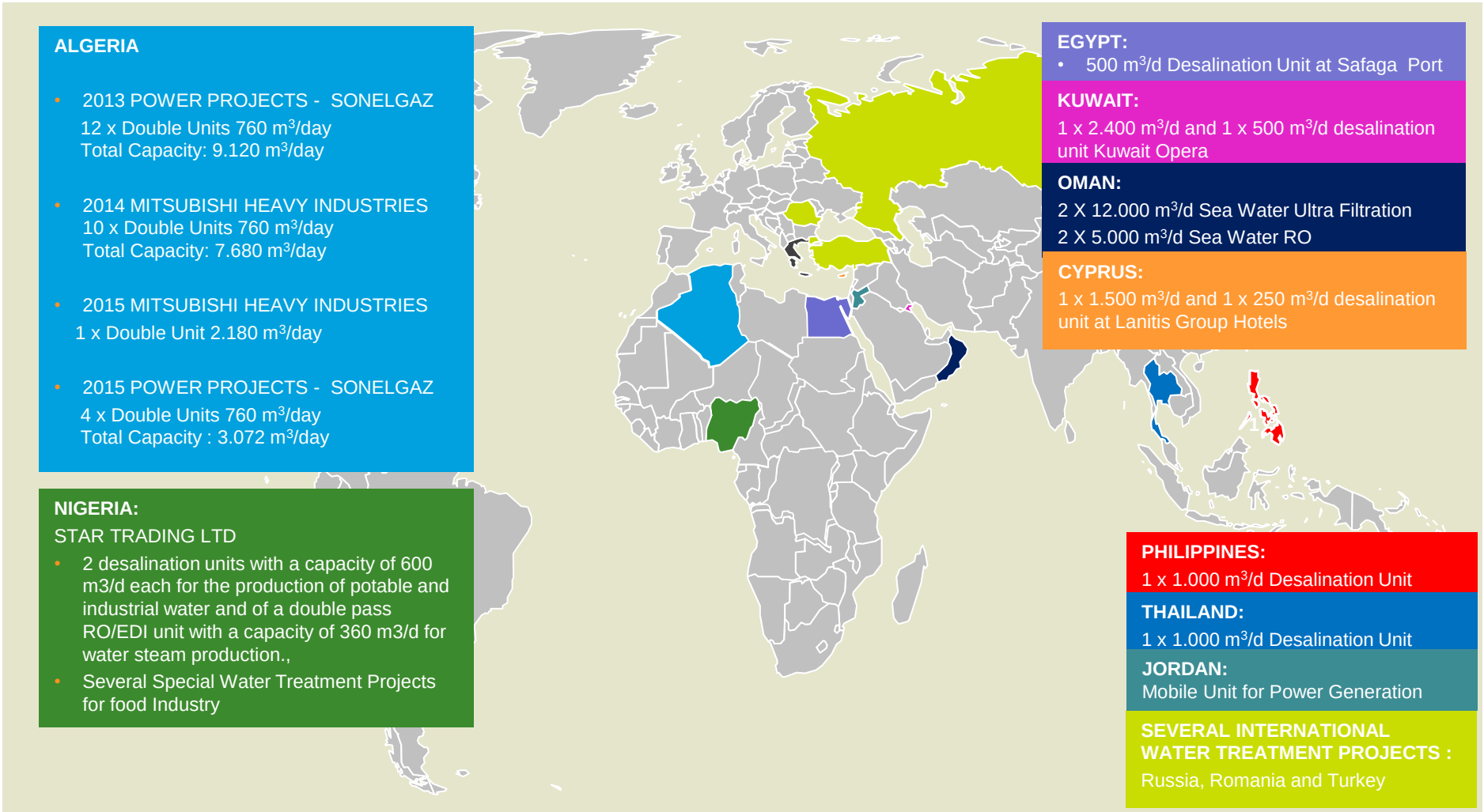
SYCHEM - International Water Treatment Market Presence



ALGERIA

- 2013 POWER PROJECTS - SONELGAZ
  12 x Double Units 760 m^3/day
  Total Capacity: 9.120 m^3/day
- 2014 MITSUBISHI HEAVY INDUSTRIES
  10 x Double Units 760 m^3/day
  Total Capacity: 7.680 m^3/day
- 2015 MITSUBISHI HEAVY INDUSTRIES
  1 x Double Unit 2.180 m^3/day
- 2015 POWER PROJECTS - SONELGAZ
  4 x Double Units 760 m^3/day
  Total Capacity : 3.072 m^3/day

NIGERIA:

STAR TRADING LTD

- 2 desalination units with a capacity of 600 m3/d each for the production of potable and industrial water and of a double pass RO/EDI unit with a capacity of 360 m3/d for water steam production.,
- Several Special Water Treatment Projects for food Industry

EGYPT:

- 500 m^3/d Desalination Unit at Safaga Port

KUWAIT:

1 x 2.400 m^3/d and 1 x 500 m^3/d desalination unit Kuwait Opera

OMAN:

2 X 12.000 m^3/d Sea Water Ultra Filtration
2 X 5.000 m^3/d Sea Water RO

CYPRUS:

1 x 1.500 m^3/d and 1 x 250 m^3/d desalination unit at Lanitis Group Hotels

PHILIPPINES:

1 x 1.000 m^3/d Desalination Unit

THAILAND:

1 x 1.000 m^3/d Desalination Unit

JORDAN:

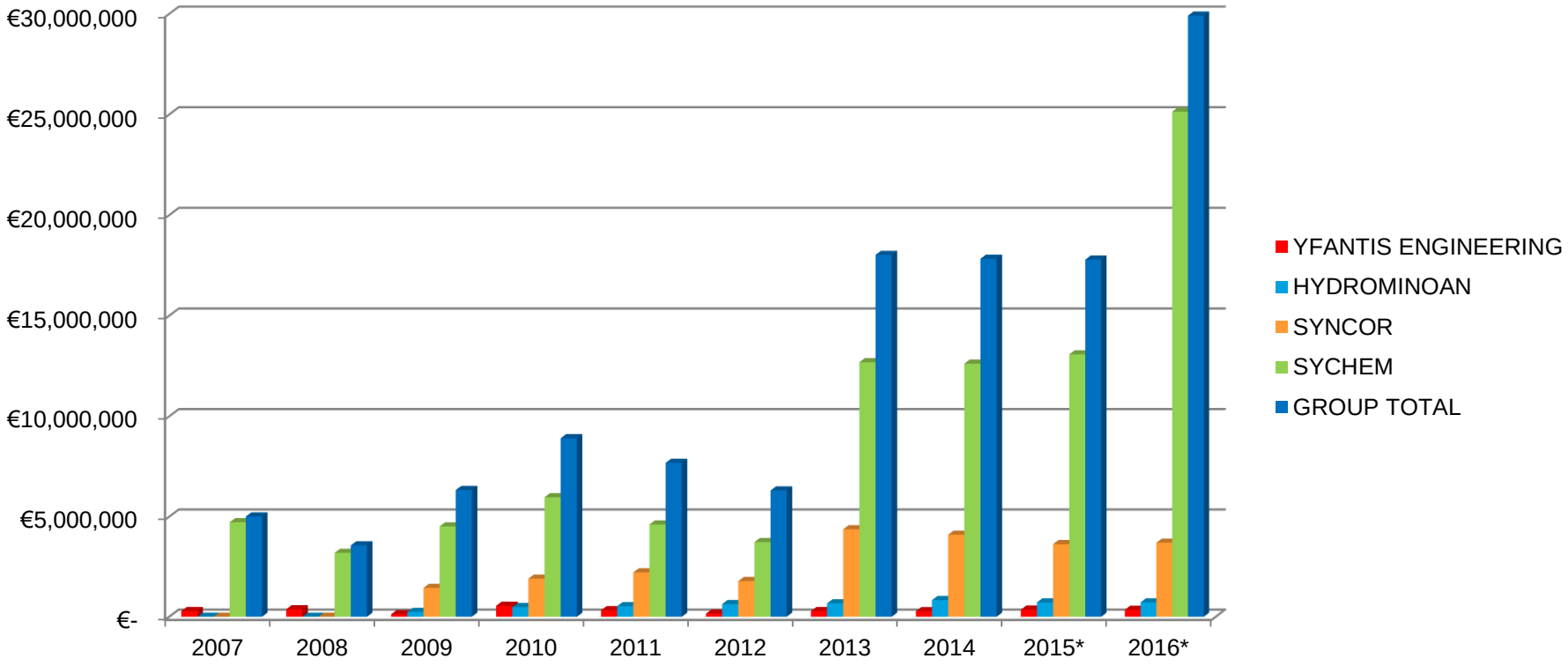
Mobile Unit for Power Generation

SEVERAL INTERNATIONAL WATER TREATMENT PROJECTS :

Russia, Romania and Turkey

SYCHEM ADVANCED WATER TECHNOLOGIES

SYCHEM Group – Annual Turnover - Progress in Decade Period



SYCHEM Group – Man Power, Investment and Facilities

2015: Average number of employees: 90 people

2016: Average number of employees: 130 people + 44%

Department	Number of staff
Management:	5
Design/development:	18
Technical and Engineering	50
Purchasing:	12
Sales/Marketing:	7
Logistics:	6
Administration, Accounting, Financial etc	30

Total investments in equipment and facilities [2011 – 2016]: 10.500.000 €

- 18.000 m^2 owned land- industrial zone Heraklion Crete
- 8.500 m^2 factory facilities
- Athens offices and warehouse: 1.100 m^2

Sychem Special Projects

In Water Treatment

Our Reference

Desalination: Desalination Unit 2.000 m³/day & Almyros Educational Desalination Park

Municipal Enterprise for Water Supply and Sewerage of Malevizi

BW75.000 (BW – UF – RO)

Total: 2.000 m³/ d

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination: Desalination Unit 2.000 m³/day & Almyros Educational Desalination Park

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BW75.000 (BW – UF – RO)

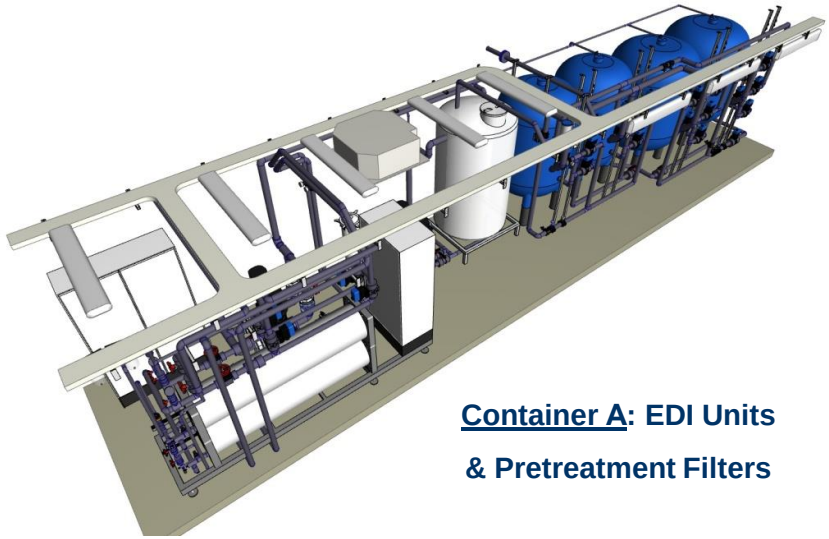
Total: 2.000 m³/ d

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination: 10+ 1 mobile water treatment systems installed in Algeria

MITSUBISHI HEAVY INDUSTRIES, LTD.



<u>Container A</u>: EDI Units

& Pretreatment Filters

WTP of 16 m^3/h demi production

12 units (16 m^3/h – 2 x 100%)

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination: 12 mobile water treatment systems for Combined Cycle Power Plants installed in Algeria

HOLDINGS MYTILINEOS

METKA

POWER PROJECTS.

WTP of 16 m^3/h demi production

12 units (16 m^3/h – 2 x 100%)

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination: 12 mobile water treatment systems for Combined Cycle Power Plants installed in Algeria

Containers installed on site

WTP of 16 m^3/h demi production

12 units (16 m^3/h – 2 x 100%)

Our Reference

Desalination: Design, construction, installation and 10 years operation and maintenance contract

MOTOR OIL (HELLAS)
CORINTH REFINERIES S.A.

Total Installed Plant Capacity: **7.400** m^3 /day UF, **9.750** m^3 /day (SWRO), 9.000 m^3 /day (2nd Pass RO), **8.900** m^3/day EDI – BFW water.

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Our Reference

Desalination project for the production of potable water

KUWAIT OPERA HOUSE

SW76.000 & SW25.000: 3.000 m^3/day (Seawater RO)

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Our Reference

Municipal of Heraklion/Skalani – Ultra Filtration Project for the production of potable water

- Capacity : 10.800 m^3/day
- 3 lines 150 m^3/h
- 50 UF membrane elements at each line with total surface 8.250 m^2.
- Recovery 93,3%

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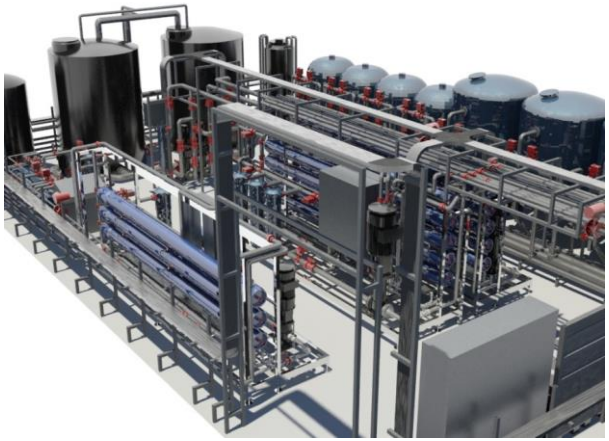
Our Reference

Desalination: Water Treatment Systems for Exporting to Nigeria – Full Preassembly and Testing at Sychem's Factory

- Pre-assembled WTP units at Ibadan - Nigeria
  - Client: STAR TRADING COMPANY LTD
  - Project: Water Treatment Plant, 1.200 m^3/d (1st Pass RO, POT Water) & 360 m^3/d (2nd Pass RO - EDI BFW)



WTP DESIGN

SYCHEM FACTORY FACILITIES, GREECE

REAL SCALE TESTING, RAW WATER SIMULATION

ROM OIL FACTORY, NIGERIA

INSTALLATION ON-SITE

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination: Private Water Production

- Hydrominoan S.A. the production & supply of potable water
  - Clients:
    - Water & Sewage Authority of Heraklion Crete
    - COCA COLA factory in Crete
    - Water Distributors with Private Trucks
  - Daily production 5.000 m^3 /day

Our Reference

Desalination: combined water treatment system with wind turbine - Design, construction, installation and 10 years operation and maintenance contract

- Milos island Green Reverse Osmosis Plant combined with wind power
  - Client: Eoliki Milos SA – ITA Group, 2007
  - Initial installation: 1.500 m^3 /day
  - Expansions: first in 2008 for 1.500 m^3 / day & second in 2009 for 1.500 m^3 /day
  - Contract: Construction, operation & maintenance of installation for a minimum production of 600.000 m^3 /year

SYCHEM ADVANCED WATER TECHNOLOGIES

Our Reference

Desalination project for the production of boiled feed water & service water for the plant

- Desalination project for the production of boiled feed water & service water for the plant
  - Client: METKA SA – Corinth Power (437 MW Combined Cycle Power Plant)
  - Year: 2010
  - Capacity: 860 m^3 /day (Seawater – UF-RO) - 720 m^3 /day (2^{nd} Pass RO – EDI)

SYCHEM ADVANCED WATER TECHNOLOGIES

SYCHEM SPECIAL PROJECTS IN ENERGY SECTOR

The Limassol Oval

- Unique Energy and Water Saving Technologies
- The First Decentralized geoexchange multi-store building in Southern Europe
- Architects: **ATKINS**
- Electromechanical Design**: Yfantis Engineering and Elemec**
- Mechanical Contractor: **SYCHEM CYPRUS**

SYCHEM ADVANCED WATER TECHNOLOGIES

The Oval: 8 of 16 floors now built

Med Sea Health – Chalkidiki (under construction)

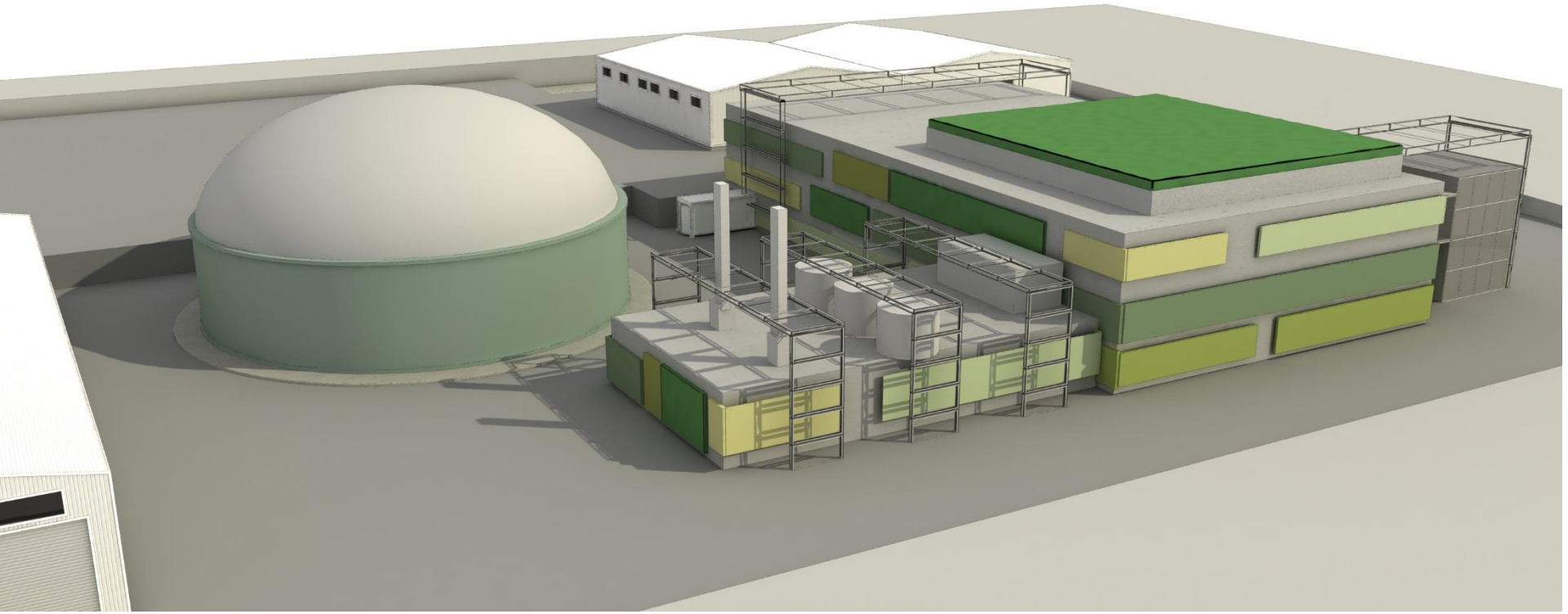
SYCHEM has been awarded as the main mechanical contractor.

Med Sea Health – Chalkidiki (under construction)

Med Sea Health – Chalkidiki (under construction)

SYCHEM GROUP
NEW INVESTMENTS

TECHNICAL BIOENERGY CRETE



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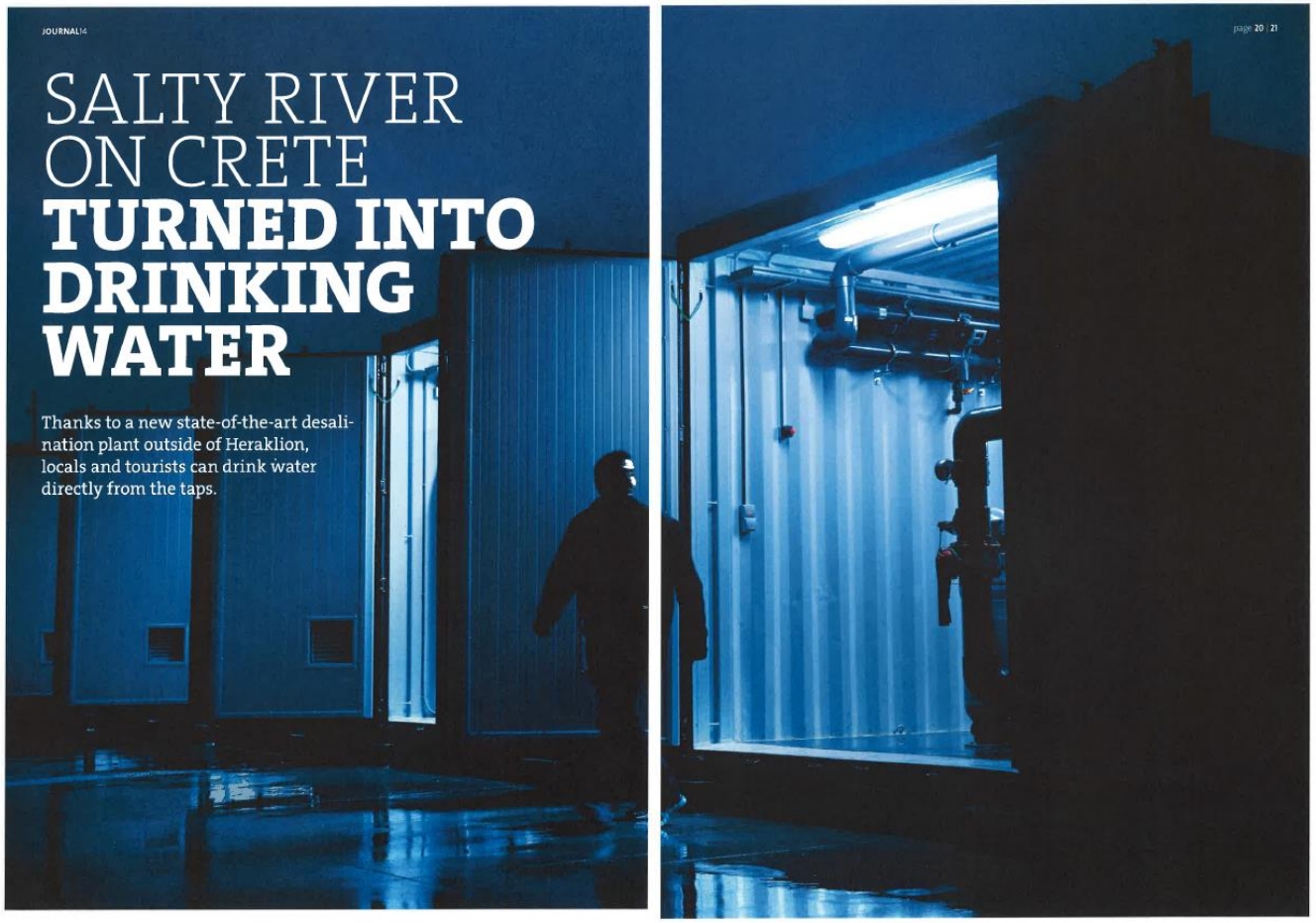
International Press & Awards

Grundfos Journal 2014



Grundfos Journal 2014

"The Almyros Desalination Park is a custom built state-of-the-art facility that can provide fresh and safe drinking water."
Notis Ellinakis

The Krousaniotakis family is delighted to be connected to the water from the desalination plant. Now the water is much cheaper and healthier for the family and five-year-old Panagiotis can drink directly from the tap.

anagiotis Krousaniotakis is home from school and can drink directly from the tap. Not far from his house, the waiters at the tavern close to the beach can serve tourists fresh water for free. And many of the nearby hotels can offer their guests water without a brackish taste.

The Greek island of Crete is a popular tourist attraction with more than 2.5 million visitors every year. Lots of them are accommodated around the island's capital city, Heraklion, where they live next to its 300,000 permanent residents. Crete has over one thousand kilometres of coastline, but the island is dry and has almost no groundwater. The islanders have therefore relied on rainwater from ancient times. In modern times, the Cretans have made use of expensive bottled water, but now innovative technology packed in four containers is about to change that.

Affordable water from salty river

SYCHEM is a Greek company which specialises in water treatment and especially in desalination using advanced technologies such as reverse osmosis and ultrafiltration. In 2014 they put a brand new public desalination plant into operation west of Heraklion, close to the river of Almyros, which is the Greek word for salty.

"The Almyros Desalination Park is a custom built state-of-the-art facility that can provide fresh and safe drinking water for a fraction of the price. And at the same time we have built the first educational facility in Europe, where people can get to know the technology and benefits of desalination," says Factory Manager, Notis Ellinakis from SYCHEM.

He explains that it is necessary to inform and educate people, since the technology has a huge potential and most of the islanders are in fact not accustomed to drinking desalinated water. Outside the plant there is an automatic dispenser, where residents can collect the desalinated drinking water for free.

A minimum of maintenance

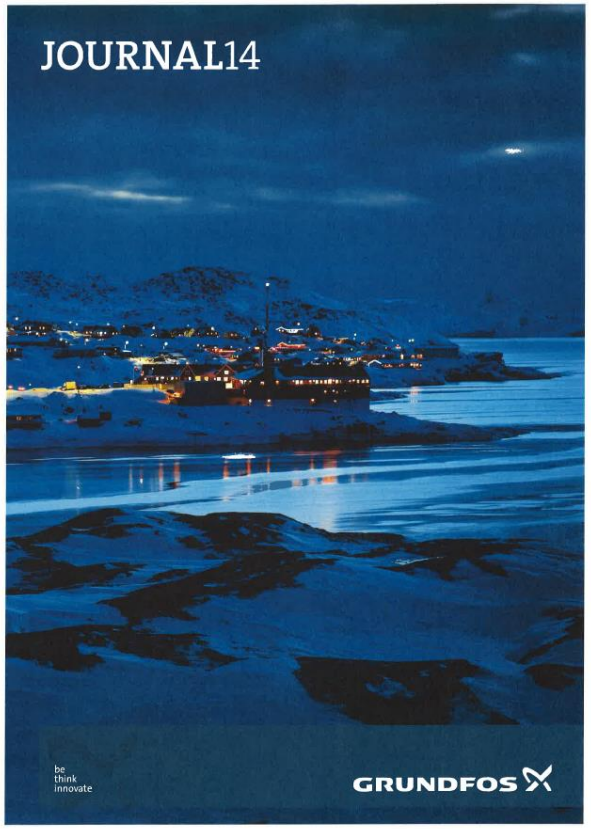
The plant is almost completely automatic. Every part of the process, from the water intake below the Psiloritis Mountain to the advanced reverse osmosis procedure, can be monitored and controlled from a computer with access to the Internet.

"Since this is a public plant, only a one-time sum of money was allocated for the project, which means that besides being automatic with a minimum of maintenance, we also had to select the best and most reliable products for the plant. For this reason we are very happy with the partnership with Grundfos," says Mr. Ellinakis.

Mutual trust

From Grundfos Hellas, Key Account Manager Dimitris Dalosis has been connected to the desalination park project and has been able to provide valuable knowledge.

"There has been a mutual trust and a common understanding throughout the whole process. When SYCHEM came to us with their needs, we were able to give them several suggestions, and they liked and followed our advice," says Dimitris Dalosis.



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DWR Aug - Sept 2015

PROJECTS

March of continuous electrodeionization in ultra pure water use

Dr-Ing A Yfantis president and managing director and **Dr N Yfantis** technical director, Sychem

Stringent boiler feedwater quality requirements arising from the advent of supercritical, high-pressure boilers has upped demands on water purification systems for steam generation significantly. And system designers still must contend with varying raw water characteristics dependent on location. The authors describe the challenges encountered at an oil industry site and the responses to them using a purification technology that is gathering favour in the sector.

WHILE LONG-ESTABLISHED demineralization resin technology can meet the quality requirements for boiler feed water, there is a widespread and increasing shift in the oil sector to continuous electrodeionization (CEDI or EDI) technology. Reasons for this shift include the elimination of hazardous regeneration chemicals and neutralization systems, a much smaller footprint, reduced overall cost of ownership – particularly in operational cost, and more consistent product water quality.

PROJECTS

Feed water quality is a particular challenge in the oil industry. Oil refineries typically are located on coasts and estuaries which dictates that seawater, or brackish water is the raw water source for their steam production. So they require desalination and further purification stages for their large volumes of boiler feed water to reduce its conductivity below 1µS/cm.

Moreover, for refineries with a cogeneration plant, usually employing combined cycle gas turbines, the standard water quality requirement is less than 0.1µS/cm, with silica at 10 parts per billion (ppb) or below. The limits for sodium, chloride and sulphate ions can each be less than 3 ppb. Such stringent specifications are necessary to protect boiler tubes and turbine blades, operating at high temperature and pressure, from scaling and corrosion.

MOVE TO CONTINUOUS DEIONIZATION

Running costs need to be closely controlled throughout the treatment process. This includes the potentially high energy costs of running RO lines. However, due to recent developments in CEDI it has become possible to design simpler, more energy efficient water purification systems based on RO (figure 1).

The latest expansions to the water treatment scheme at Motor Oil (Hellas) Corinth Refineries provide an example of oil-sector growth in the deployment of CEDI and its benefits. As a result of these expansions the company now has the largest seawater desalination system in Greece, with a production capacity exceeding 7,000 m³/d and outstanding operating economics.

Sychem secured the contract to design and build the desalination project, operating and maintaining it over ten years, as an addition to the refinery's existing multi stage flash (MSF)/ion exchange (IX) desalination plant.

The project began with Sychem's construction of a 1,100 m³/d potable water unit with two-pass reverse osmosis (RO). Two expansion phases followed, based on seawater ultrafiltration (UF) and seawater reverse osmosis (SWRO) for boiler feed water production incorporating Ionpure CEDI modules:

- initial construction 2007: 1,100m³/d (1st pass RO) – 500 m³/d (2nd pass RO);
- expansion 2010: 3,700 m³/d (1st pass UF+SWRO) – 3,200 m³/d (2nd pass RO+CEDI); and
- Expansion 2013: 3,700 m³/d (1st pass UF+SWRO) – 3,200 m³/d (2nd pass RO+CEDI).

To summarize, the Sychem plant now installed and in full operation comprises the following elements:

- eight multimedia filters (MMF) treating the return seawater feed;
- six activated carbon filters treating the return seawater feed;
- four lines of 5,000 m³/day seawater UF systems;
- four lines of 1,800 m³/day seawater RO;
- four lines of 1,530 m³/day 2nd pass RO; and
- two CEDI units totalling 6,000 m³/d (one unit for each pair of RO lines).

In the past, IX, or mixed bed deionization (MBDI) would have been the sole option for the demineralization process performed by CEDI in the Corinth refinery. However, the performance of CEDI modules has been developed such that the technology now equals, or betters what is achievable using MBDI. High-flow Ionpure VNX modules achieve greater than 95% silica removal and greater than 99.5% sodium removal from RO permeate and they can also be specified to meet a variety of stipulated feedwater and product water qualities.

PAYBACK

A feature of Sychem's treatment plant design is that it uses warm return seawater from the refinery's cooling system. The capacity to utilize this water, with raised temperature and high suspended solids, is created by the combination of MMF and UF in a pre-treatment stage. In addition, energy is recovered in the SWRO system, using pressure exchangers to reduce power consumption by the RO water-lubricated piston, booster pumps (figure 2).

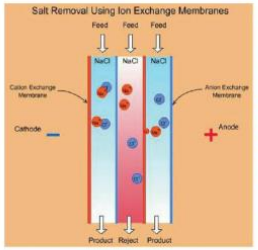


Figure 1. Schematic for CEDI.

Figure 2. pressure exchangers reduce energy use in the RO booster pumps.

PROJECTS

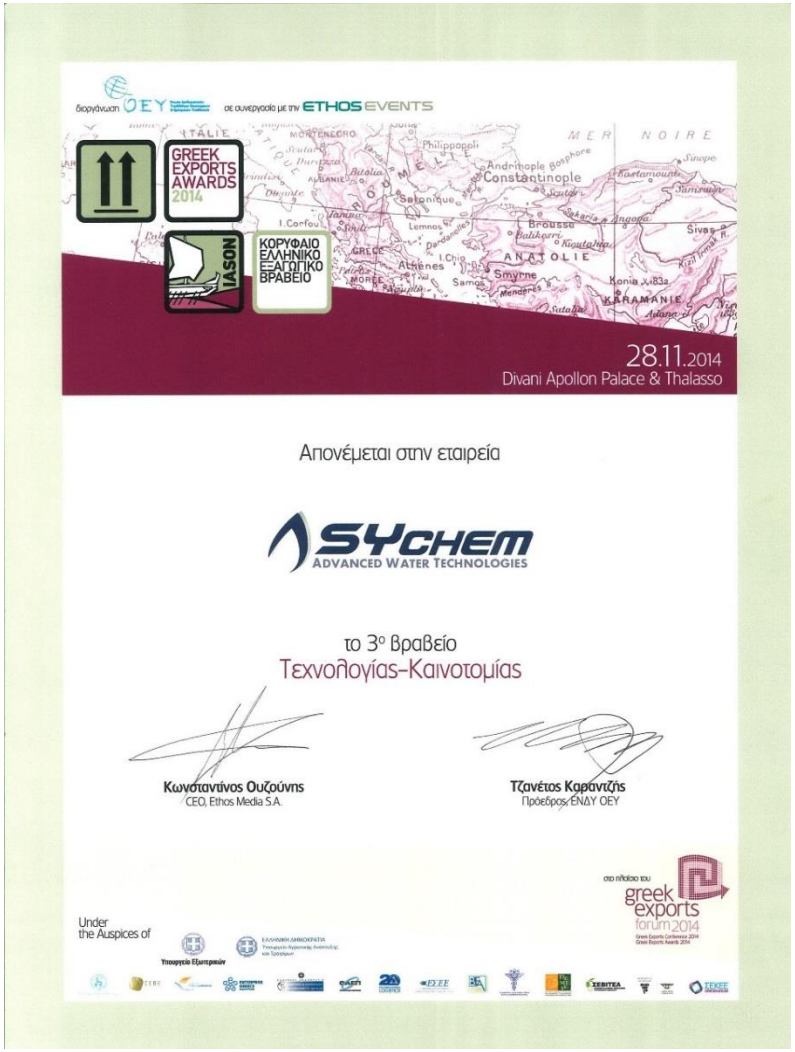
PROJECT PROGRESS

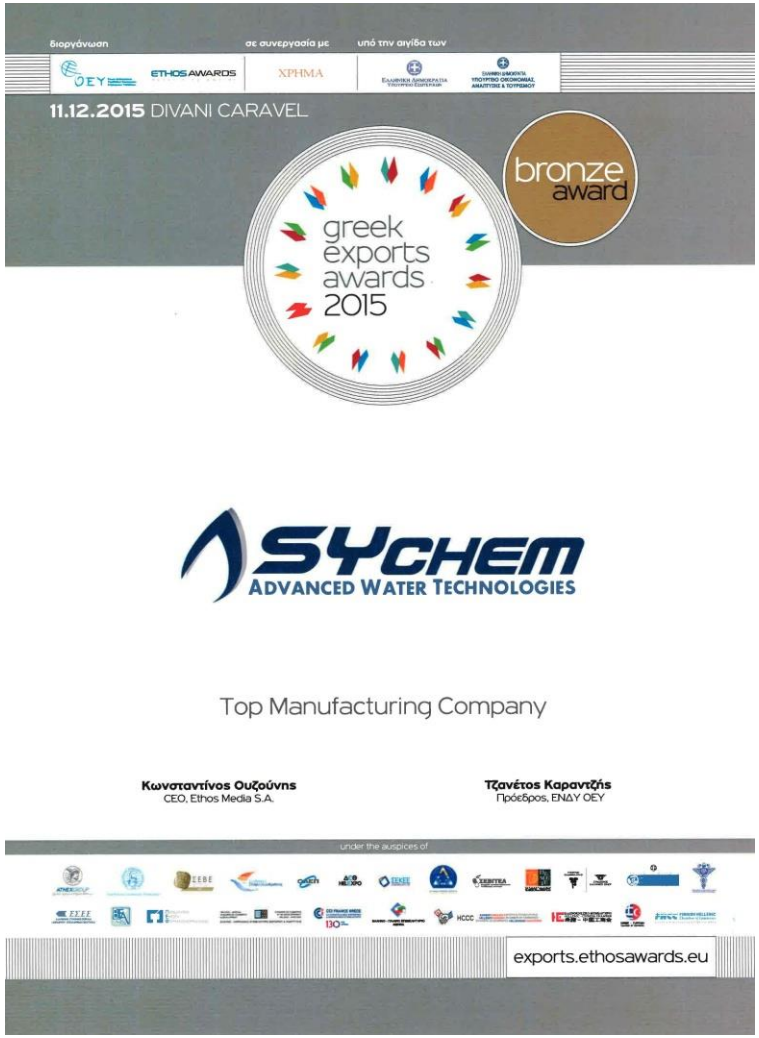
CALIFORNIA REGULATORS ADOPT RULES FOR PERMITTING DESALINATION

TEXAS DESALINATION BOOSTER BILL GOES TO SENATE

SYCHEM ADVANCED WATER TECHNOLOGIES

Greek Exports Award 2014 - 2015





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