Desalination Report
Global 2010

First Edition, 2010

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ABS Energy Research
8 Quarry Road
London SW18 2QJ
United Kingdom
Tel: + 44 020 8871, 2752
Fax: + 44 020 8328 7117
info@absenergyresearch.com

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The Desalination Report
Ed 1 2010

Introduction

- Water scarcity has always existed somewhere in the world but today the need for water, both for people and for industry, is growing at an alarming rate
- About one third of the countries in the world suffer from water shortage and in 20 of these real scarcity exists. With water shortage comes creeping desertification, pollution of surface water and salt contamination of fresh water
- Fortunately the technologies of desalination (also called desalting) exist to remedy these critical problems, they are now affordable and are becoming cheaper
- By 2010 there were over 14,450 desalination plants operating in 100 countries
- Desalination can be useful in varying situations. In isolated arid places with no surface water it can be the lifeblood of a community or industry, making existence possible, no less. In less extreme situations desalination can be a valuable addition to regular water supply, remedying shortages and providing continuous supply.
- Undrinkable water is classified as one of two types; “brackish” water in rivers, and “sea water” with high salinity in the oceans. The technologies and costs of desalinating these two types of water differ. Desalting sea water consumes much more energy.
- Once considered too expensive and energy intensive to use on a large scale, the costs of desalinating water have declined to $0.45 (with subsidies) to $1 per m3 to produce. This is due to technological advances such as improvements in energy efficiency by energy recovery devices, and an increase in the lifetime of desalination plants.
- As the price of desalinating water continues to fall, it may cost no more than freshwater extraction by 2020 in some parts of the world.
- Desalination is a real option for governments

Report Scope

- The report outlines the principal types of water desalination technologies in current use: **distillation or thermal (MSF - multi stage flash distillation or MED – multi effect desalination)**, including cogeneration of electricity and water; and **membrane, mainly reverse osmosis (RO**), followed by **electrodialysis (ED)**.
- Thermal desalination technologies are popular in regions with cheap energy, such as the Middle East, and are often coupled with electricity generation from plentiful and cheap local hydrocarbon resources. However, globally there is a trend towards membranes, mainly RO. 59% of contracts in the pipeline are RO, 27% MSF, 9% MED and 4% ED.
- The report surveys the usage of desalination in 50 countries and summarises regions, listing decision-makers and customers for the technology. The major suppliers and manufactures of desalination equipment are listed and ranked by capacity installed.
- Global capital expenditure on new and replacement desalination plants is expected to grow from $5.8 billion in 2009 to $13.4 billion in 2015. During this period O & M will grow from $7.1 billion to $16.3 billion. Most of the investment will be from the private sector, especially small and medium operators.
- Desalination is often associated with the MENA countries, which are the most arid in the world and do constitute the largest market for desalination. The Gulf area will continue to be the largest market, with its rapidly growing populations, depleted ground water resources and the need for replacement capacity for old plant built 30-40 years ago.
- Desalination is linked with energy production and transformation and large integrated water and power plants (IWPP) are especially common in the Middle East, where seawater and hydrocarbon energy are readily available but potable water is scarce or non-existent. .
- The sector is expected to experience annual growth of 10-12% until 2030 mainly in China, India, Japan, the USA, Australia, Spain and Northern African countries, with continued growth in the Middle East.
- The use of desalination is growing in the Mediterranean countries, notably in Morocco, Algeria, Tunisia and Spain. These countries will experience the highest growth, and will double or triple in the next few years.

- The US is mainly a brackish water market, with desalination plants located in coastal areas, desalting river water. However there will be more large-scale seawater desalting plants built, most likely in California, Texas and Florida. The municipal market in the US is expected to grow.
- China and India both experience acute water shortages and have the two largest populations in the world, together with rapid industrialisation requiring huge water consumption. Both are constructing desalination plants.

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1 Desalination Technologies

Two types of water desalination technologies are in current use:

- distillation or thermal (MSF or MED), which includes cogeneration of electricity and water and is predominant in the Gulf
- membrane, of which reverse osmosis (RO) is the leading technology, followed by electrodialysis (ED).

Other desalination processes are under development but are not yet competitive.

1.1 Thermal

Thermal desalination exploits the fact that water molecules vaporise at a lower temperature than dissolved salts and other molecules. Therefore, feed water can be heated and then evaporated to separate out the dissolved salts from pure water.

Three different thermal desalination technologies have emerged: multistage flash (MSF), multi effect distillation (MED) and mechanical vapour compression/ vapour compression (MVC/VC).

1.2 Multistage Flash

Multi-stage flash desalination occurs through a series of stages (Figure 1):

1. The feed water, usually seawater, passes through a heating stage.
2. The feed water is heated in successive stages.
3. Then the feed water is heated in a brine heater using externally supplied steam.
4. After that, the feed water is passed through various stages and is subjected to several ‘flashes’ of heat. The temperature and pressure of each successive stage declines.
5. The water boils, evaporates, condenses and the pure water produced is collected.

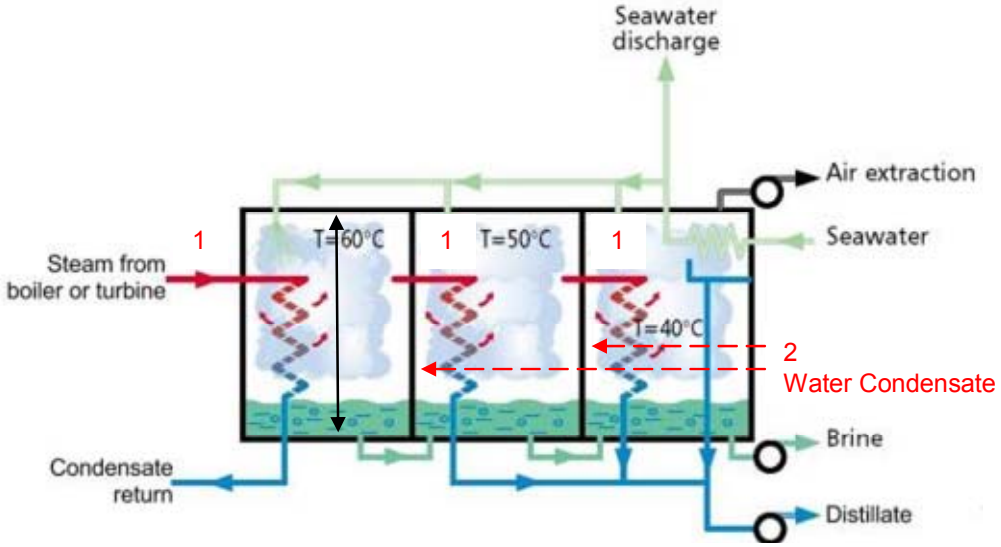

Figure 2. *Diagram of Multi Effect Distillation plant*

Source: *Sidem-desalination*

Most MED plants are medium-sized – produce up to 300,000m^3 of water per day. The capital costs for these plants have declined in recent years due to the use of low-cost materials which make the plants easier to operate and more economic; however, they are less rugged.

1.4 Mechanical Vapour Compression / Vapour Compression

MVC/VC works on the same principle as MSF and MED, except it uses mechanical energy as a source of heat (Figure 3). VC plants are a lot smaller than MSF and MED plants and are mainly used to supply water to tourist resorts and small industrial sites. They are found in locations where the cost of electricity is very low or thermal heat is not available.

All three processes are used to desalinate very saline sea water, large quantities of lower salinity water or very hot waters. The water produced is extremely pure and often has an industrial use. They all need thermal and electrical energy in relatively large quantities compared to membrane desalination processes. It is estimated that 2/3rds of all desalination plants use thermal energy.

Recent developments in thermal desalination technologies include: the use of cross-tubes to move the seawater around the system; the use of high-grade materials to reduce corrosion problems; reduction in the number of stages used; the development of additives to prevent scale formation; and special sponge-ball cleaning systems to improve the reliability of the plant and water capacity. All of these developments have helped to increase the life-time of

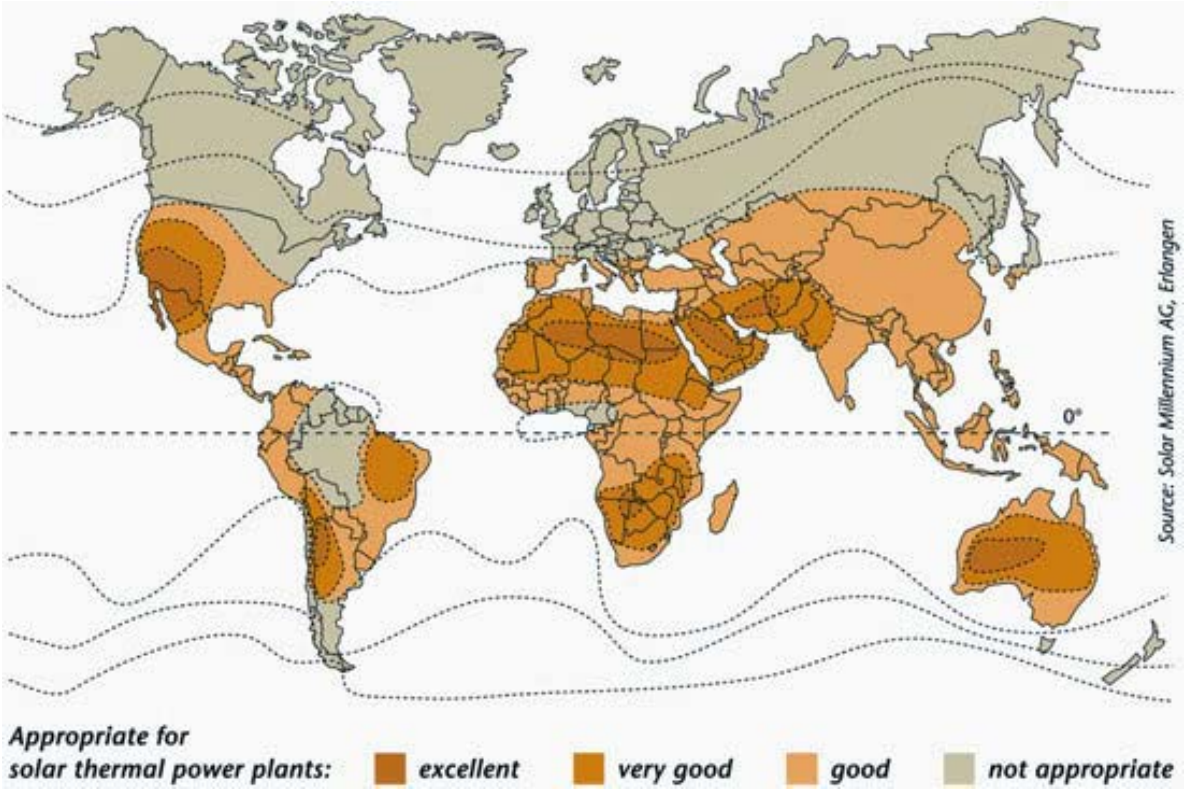

Figure 13. *Global regions appropriate for solar thermal power plants*

Source: *Solar Millenium AG, Erlongen*

Table 5. *Global concentrating solar power projects for both solar PV and solar thermal*

Country	Units MW	Country	Units MW
Algeria	20	Italy	28
Australia	10	Morocco	20
China	50	South Africa	100
Egypt	25	Spain	2,232
Greece	52	UAE	100
India	10	USA	3,9125,352
Israel	250		

Source: *Reaccess, 2009*

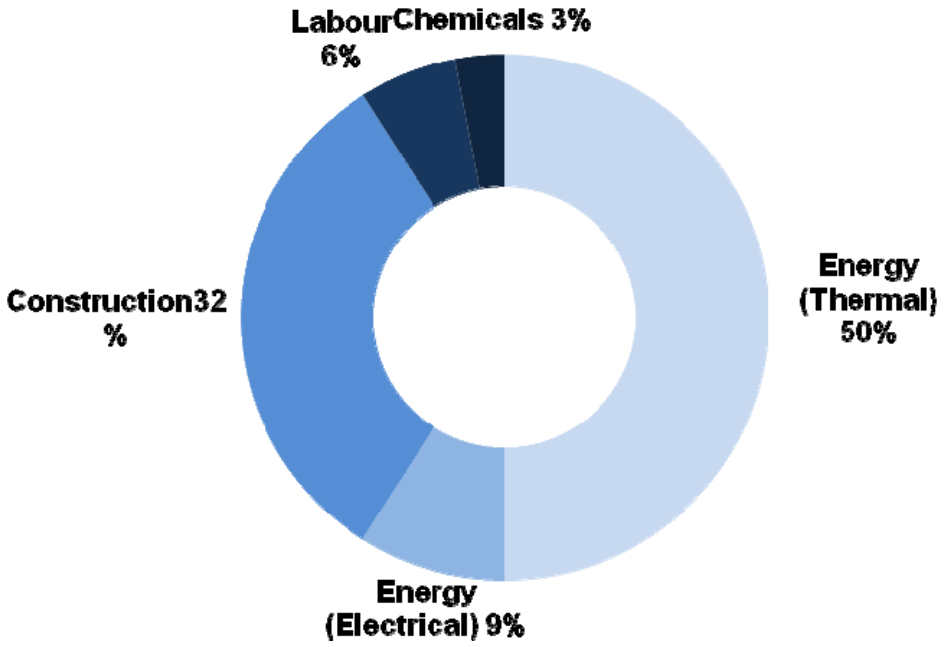

Figure 37. *Typical costs for a very large salt water thermal desalination plant*

Source: *Wangnick, 2002*

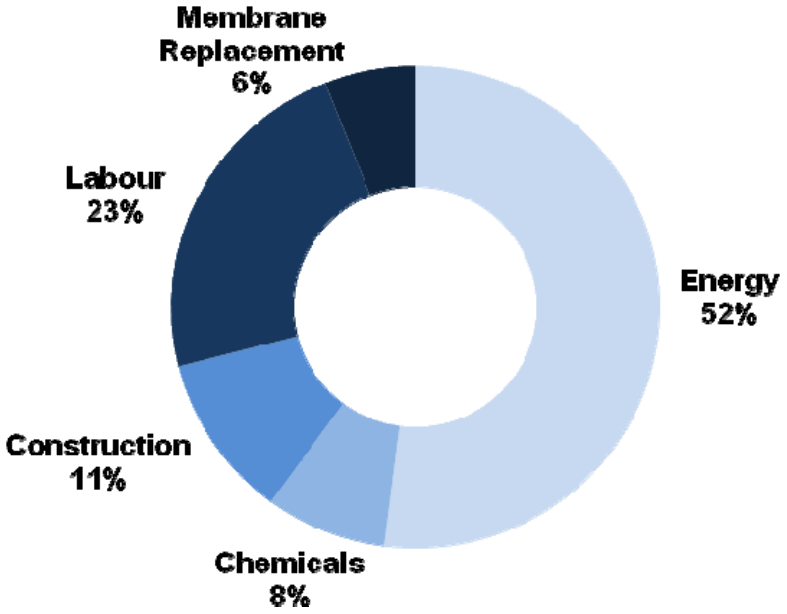

Figure 38. *Costs of water production for a 100 million litre per day seawater RO desalination plant*

Source: *Adham, 2007*

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