Chapter 28. Desalinization

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1. Introduction

Desalinization of seawater is an essential process for the support of human communities in

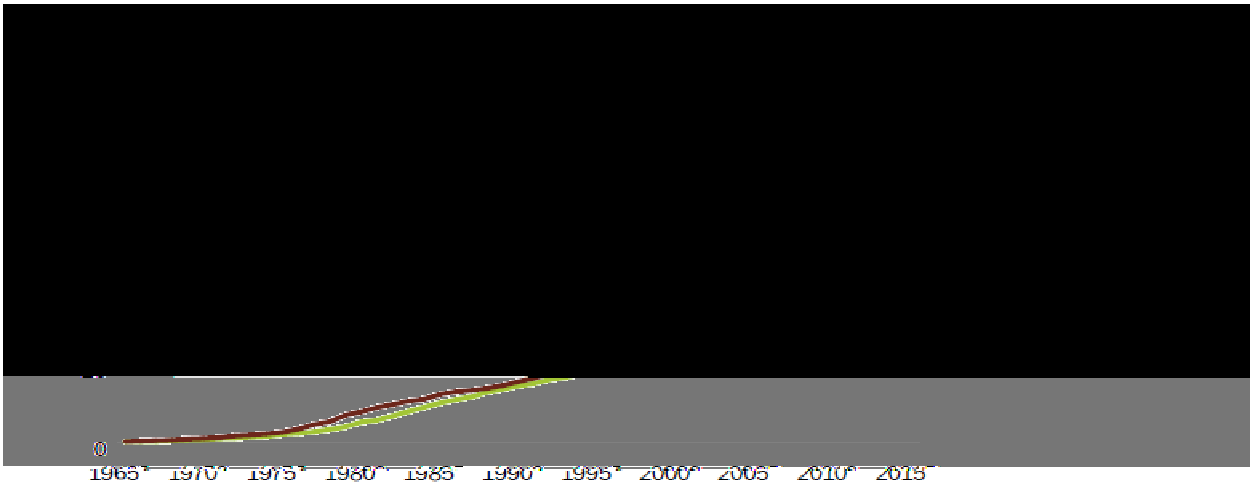

Figure 1. Global desalinization capacity 1965–2015. Source: GWI, 2015. "Contracted" covers plant that is complete or under construction; "commissioned" covers plant that is in operation or is available for operation.

Historically, human settlements have tended to grow up where freshwater was available, and their growth has been conditioned by freshwater availability and the possibilities of bringing it to serve the settlement. As long ago as 312 BCE, the Romans had to build a 16.4-kilometre aqueduct to bring water to Rome in order to avoid this constraint (Frontinus). Desalinization represents an alternative technology for avoiding this constraint on the growth of human settlements in areas with very limited availability of freshwater. That capability, however, comes at the price of considerable capital investment and energy consumption. Gleick et al. (2009) give an overview of the worldwide distribution of desalinization capacity in 2009.

The nature of the industry, however, varies in many ways between the different regions, particularly in respect of the technology used: the Middle East has relied more on thermal processes, while the United States has relied more on membrane processes. Thermal processes (mainly Multi-Stage Flash (MSF) and Multiple-Effect-Distillation (MED)) evaporate the water and then re-condense it. At peak performance these distillation processes produce a freshwater output of about 30-40 per cent of the seawater taken in. The residue has to be discharged as brine. Membrane-based processes (such as reverse osmosis (RO), electro-de-ionization (EDI) and electro-dialysis (ED)) force feed-water through a semi-permeable membrane that blocks various particulates and dissolved ions, leaving the feed-water behind as an enhanced brine, with or without further refinements. (Details of these processes can be found in WHO, 2007 and in GCC, 2014). The energy needed for all forms of desalinization is usually obtained from fossil fuels. However, combined plants for nuclear power generation and water desalinization have been developed in a number of places (for example, Argentina, India, Japan and Pakistan), and the International Atomic Energy Agency has conducted studies on how far this might be developed (IAEA, 2007). At present, very little desalinization is powered by solar energy.

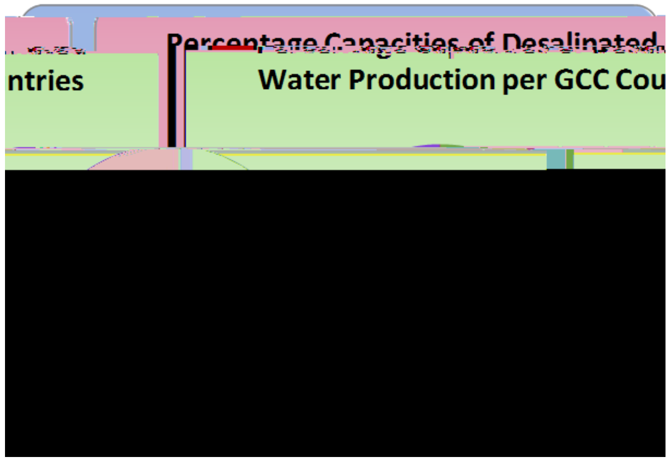

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Figure 4. Desalinization capacity in the GCC States, 2012. Source: GCC, 2012

The practice of desalinization in the GCC States is heavily influenced by the high level of electricity consumption, which is largely due to the demand for air-conditioning and cooling, necessary in the in climate, and to the intensive petro-chemical industries. The demand for electricity and water is also influenced by the pricing policy. Water and are a commonplace practice among the GCC countries.

aviding inflationary pressures, and political considerations. The result of the lower prices is to increase demand for both electricity and water. However, is widespread recognition of the harmful effects caused by the current water and electricity tariff rates (Saif, 2012).

The high level of use of thermal technologies for desalinization in the GCC States is mainly due to the predominant method of electricity generation, which is through gas-fired power plants. A by-product of the electricity generation process is steam, which can be utilized by MSF and MED thermal desalinization plants for their energy needs. The two plants need to be co-located in order for the desalinization plant to capitalize on the power stations' by-product of steam. This co-location of power and plants is referred to as co-generation. Roughly 60 per cent of the MSF plants in the United Arab Emirates are co-generation, while that percentage stands at 70 per cent

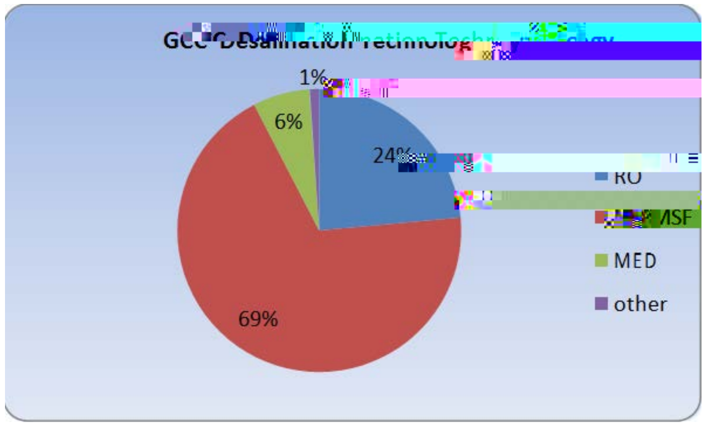

Figure 5. Use of the different Desalinization Technologies in GCC States. Source: GCC, 2012.

Although this was the balance between thermal and membrane technologies in the GCC States in 2012, the situation is changing quickly, because the GCC States will in future be adopting more RO projects, as a step towards minimizing energy consumption and decreasing environmental impacts. Most of the desalinization plants under construction in 2012 were RO or combined RO/MSF, and the balance is expected to change even more in the future (GCC, 2012).

The GCC States are continuing to invest heavily in their water and energy sectors as shown by many independent water and power plant (IWPP) projects. For example, in 2009, Qatar initiated a 30-year water and electricity master plan that will see major investments in desalinization, water infrastructure and wastewater treatment (GWI, 2015). Between 2010 and 2015, Qatar plans to invest approximately.

2.3 Other States in the Persian Gulf area

associated bodies were to implement as a matter of urgency. This list included about 20 desalinization projects (Spain, 2005). The desalinization component of the Plan is reported to have had an estimated cost of about 3,000 million dollars. By 2013, 27 of the 51 approved plants had been built at a cost of about 2,200 million dollars. However, the economic recession starting in 2008 is reported to have reduced the demand for water to such an extent that many of the plants are standing idle or working at well below their planned capacity (Cala, 2013).

3.7 Other States

Many small islands have very limited natural freshwater resources, and hav 0 Tw 12.19 0 Tl59 and pollution.

As the description of the nature, location and magnitude of desalinization shows, there are parts of the world where desalinization is essential to human populations at present, or greater, levels. The largest area of this kind is the six GCC States, but island States, such as Malta and Singapore, are also in this category. Such States are likely to continue to generate significant growth in population over the coming years, together with the associated economic development. The only source of additional

least as a fall-back provision for periods when natural freshwater supplies are deficient.

There are many commercial firms specializing in the design and construction of desalinization plants. The technology is therefore available on the market. States and communities, however, need to have the capaciti

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