Research Office
Legislative Council Secretariat

Fact Sheet

Seawater desalination in Israel

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1. Introduction

1.1 Israel is a country in the Middle East comprising almost entirely of drylands. In face of very limited supply of fresh water, the Israeli government has relied heavily on seawater desalination to meet growing demand for water from the local population. This fact sheet first reviews water supply management in Israel, followed by discussions of its development of large-scale desalination plants in the country in recent years.

2. Water supply management in Israel

2.1 In Israel, the Ministry of National Infrastructure, Energy and Water Resources has established the Water Authority for regulation and management of water resources, including seawater desalination, developing new water resources, preserving natural water resources, and monitoring water quality. Mekorot, a government-owned water company, is responsible for operation of a water supply network known as the National Water Carrier across the country.

2.2 Total water usage in Israel amounted to about 1 990 million cubic metres ("cu m") in 2014, of which 56% was for agricultural use, 38% for domestic use and 6% for industrial use. Total water consumption is expected to increase by 31% to over 2 600 million cu m by 2020 and further by 35% to 3 500 million cu m by 2050. However, the availability of natural water resources is expected to drop by 15% by 2050 amid climate change. In face of water scarcity, the Israeli government launched a nationwide seawater desalination master plan in 1997, building desalination plants to produce potable water primarily for domestic consumption. Currently, there are five desalination plants providing about 600 million cu m of desalinated water each

year, equivalent to about 30% of daily water consumption in 2014. It is expected that the supply of desalinated seawater would increase by a total of 25% to 750 million cu m by 2020, accounting for a third of total water demand.[1]

2.3 On top of desalination, the following water supply measures have also taken in Israel, such as (a) regulation of excessive abstraction of water from the Sea of Galilee (Lake Kinneret) and aquifers; (b) adoption of drip irrigation system; and (c) promoting extensive use of reclaimed water for irrigation purpose.[2] All these measures try to maintain an optimal balance between water demand and supply for sustainable development in Israel.

3. Reverse osmosis desalination technology in Israel

3.1 All seawater desalination plants in Israel adopt the **technology of reverse osmosis ("RO")** in the desalination process. RO technology is now the most common form of seawater desalination in the world, accounting for 65% of the total in 2014. RO is also the technology applied to the Tseung Kwan O Desalination Plant under planning.[3]

3.2 RO is a desalination process with the use of semi-permeable membranes which allow the passage of water molecules but not the dissolved salts. In the process, seawater is pre-treated to remove suspended solids. Sufficient pressure is then applied with the use of high pressure pumps to force water passing through the semi-permeable membranes, leaving the dissolved salts behind. Desalinated water then undergoes post-treatment, such as pH adjustment and disinfection, to make it suitable for drinking (**Figure 1**).

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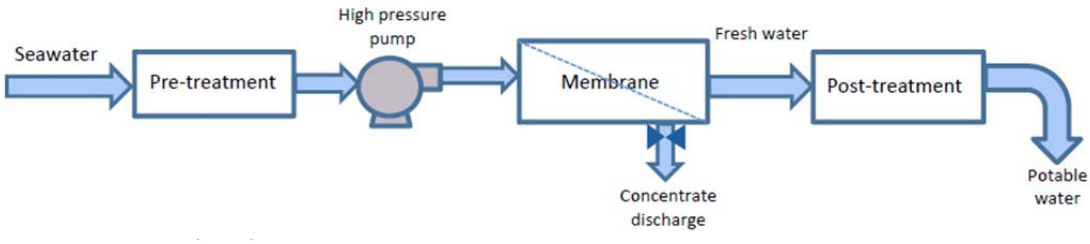
1 See Organisation for Economic Co-operation and Development (2015).

2 About 75% of wastewater is recycled for irrigation in the agricultural sector. As agriculture is the largest water-consuming sector, using recycled water from wastewater for irrigation helps save the limited potable water for domestic use. Use of drip irrigation can save large amounts of water and may save over 50% of water, depending on the type of crop.

3 The Tseung Kwan O Desalination Plant is scheduled for completion in 2020-2021 with an annual capacity to provide 50 million cu m of fresh water or 5% of the total fresh water supply, expandable to 100 million cu m or 10% in the future. The estimated cost of water at 2013-2014 price level was HK$12.6 per cu m, with breakdown of HK$4.6 capital cost of the plant, HK$3.6 energy cost and HK$4.4 treatment, distribution and customer service costs.

Figure 1 – Basic process of reverse osmosis



Source: Banat, F. (2007).

3.3 Higher water recovery rate and lower energy requirement of RO technology make it a preferred technology compared to other options.[4] On the other hand, RO membranes are typically made of cellulose acetate or other composite polymers susceptible to fouling, resulting in lower quality of desalinated water. Moreover, it is rather costly to replace membranes on the one hand, and pre-treat seawater to mitigate fouling on the other. Both of them will add to the cost of fresh water production.

4. Large scale seawater desalination plants in Israel

4.1 There are five seawater desalination plants in Israel: Ashkelon, Palmachim, Hadera, Sorek and Ashdod, all located along the Mediterranean coast to facilitate the transfer of seawater to the desalination plants. Except the Palmachim plant[5], all were built using the **build-operate-transfer model**. At the end of contract period of 25 years, the plants would be transferred to the government. The Water Authority agreed to purchase an annual volume of desalinated water from all the desalination plants, and the purchase price is made up of a fixed component and a variable component varying with factors such as energy and operation costs. In terms of production capacity, the Ashkelon, Hadera, Sorek and Ashdod plants are currently the largest in Israel, each with an annual capacity of over 100 million cu m.

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[4] Another commonly used technology is multi-stage flash evaporation of thermal desalination. Seawater is heated and evaporated, and then pure water is obtained by condensing the vapour. This method is energy-intensive and has lower water recovery rate, yet it is relatively simple to operate and produce high-purity water. This method is mostly used in those places in Middle East where solar energy is available and energy costs are of less concern. The water recovery rate of RO is about 50% and that of multi-stage flash evaporation is about 30%.

[5] The Palmachim plant was built using build-operate-own model. When it commenced operation in 2007, it had an annual capacity of 30 million cu m and subsequently increased to 90 million cu m in 2013.

4.2 The **Ashkelon plant** in southern coast city Ashkelon was built at an estimated cost of US$212 million (HK$1.7 billion). It started operation in late 2005 with an annual production capacity of 115 million cu m that could meet about 16% of total domestic water consumption in Israel. The water price for the Ashkelon plant was US$0.7 (HK$5.5) per cu m in 2015.

4.3 The **Hadera plant** in the northern coastal city of Hadera, has been expanded to increase its annual capacity from 100 million cu m to 127 million cu m in 2009, meeting about 17% of total domestic water consumption in Israel. The estimated total project cost, including the expansion cost, amounted to US$377 million (HK$2.9 billion). Comprising of two sub-plants, each can operate independently with the same production capacity. It is designed to have an independent natural gas power plant and energy recovery devices. The water price of Hadera plant was US$0.65 (HK$5.1) per cu m in 2015.

4.4 The **Sorek plant** is located in the Tel Aviv District, a coastal city in the central-west Israel. It was built at a cost of US$400 million (HK$ 3.1 billion).[6] Commissioned in 2013, the Sorek plant is the largest seawater desalination facility in Israel, with an annual capacity of 150 million cu m to provide 20% of total domestic water consumption. The plant has its own independent power plant to generate energy for operation. The power plant runs on natural gas with less carbon dioxide emission, and its fuel cost is about 7% cheaper than that of a coal-driven power system. Excessive energy produced is sold to the national power grid. Furthermore, the Sorek plant is designed with energy recovery devices throughout the desalination process to achieve energy efficiency. In 2015, the Sorek plant charged US$0.52 (HK$4.0) per cu m of desalinated water.

4.5 The **Ashdod plant** is the newest desalination facility in Israel, which has been open for operation since 2015, with an annual production capacity of 100 million cu m. The plant contains two sub-plants, each with separate water and electricity supply to ensure independent operation. The project cost was about ILS 1.5 billion[7] (HK$3.3 billion). The purchase price of the water has been set at ILS 2.40 (HK$5.3) per cu m.[8] The plant is designed to operate with variable output within a day for optimizing electricity costs with energy recovery devices also.

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6 The Sorek plant is owned by IDE Technologies Ltd and Hutchison Water International Holdings Pte Ltd (a subsidiary of Hong Kong-listed Hutchison Whampoa Limited).

7 ILS is the currency code for the Israeli new shekel (the currency unit of Israel).

8 See Israel Ministry of Foreign Affairs (2011a).

4.6 The Israeli government is planning to build **a new desalination plant in the Western Galilee** region in the northern Israel, the only part of the country without access to desalinated water from other existing plants. Meanwhile, the most important natural freshwater source in northern Israel – Sea of Galilee (Lake Kinneret) has been drying up and its water level has fallen below the red line for four consecutive years.[9]

4.7 While increasing water supply through desalination is of national importance in Israel, there is also **extensive environmental attention** to the establishment and operation of the desalination plants. In considering the proposed desalination tenders, environmental factors like measures minimizing the impact to the environment, are given a weighting of 7.5 out of 100 points. In the course of operation, the desalination plant has to monitor the marine environment and annually renew the permit for approval to discharge water to the sea with the Ministry of Environmental Protection.

[9] See CBN News (2017).

References

1. Banat, F. (2007) *Economic and technical assessment of desalination technologies*. Available from: https://www.desline.com/Geneva/Banat.pdf [Accessed July 2017].

2. CBN News. (2017) *Sea of Galilee Water Level at Record Low*. Available from: http://www1.cbn.com/cbnnews/israel/2017/march/sea-of-galilee-water-level-at-record-low [Accessed July 2017].

3. Central Bureau of Statistics. (2016) *Israel in Figures 2016*. Available from: http://www.cbs.gov.il/www/publications/isr_in_n16e.pdf [Accessed July 2017].

4. Foundation for Water Research. (2015) *Desalination for Water Supply*. Available from: http://www.fwr.org/desal.pdf [Accessed July 2017].

5. Israel Ministry of Foreign Affairs. (2011a) *Agreement signed for construction of desolation plant in Ashdod*. Available from: http://embassies.gov.il/MFA/InnovativeIsrael/economy/Pages/Agreement_signed_desalination_plant_Ashdod_11-Aug-2011.aspx [Accessed July 2017].

6. Israel Ministry of Foreign Affairs. (2011b) *One of the Biggest Desalination Plants to be Built in Sorek*. Available from: http://mfa.gov.il/MFA/InnovativeIsrael/Economy/Pages/Desalination_plant_Sorek_23-May-2011.aspx [Accessed July 2017].

7. Israel Water Authority. (2010) *Sea Water Desalination in Israel: Planning, Coping with Difficulties, and Economic Aspects of Long-term Risks*. Available from: http://www.water.gov.il/hebrew/planning-and-development/desalination/documents/desalination-in-israel.pdf [Accessed July 2017].

8. Israel Water Authority. (2012) *Long-Term Master Plan for the National Water Sector*. Available from: http://www.water.gov.il/Hebrew/Planning-and-Development/Planning/MasterPlan/DocLib4/MasterPlan-en-v.4.pdf [Accessed July 2017].

9. Israel Water Authority. (undated) *A desalination plant in the Western Galilee*. Available from: http://www.water.gov.il/Hebrew/about-reshut-hamaim/The-Authority/Pages/desalination-galil.aspx [Accessed July 2017].

10. Organisation for Economic Co-operation and Development. (2015) *Water Resources Allocation: Sharing Risks and Opportunities*. Available from: http://www.oecd.org/israel/Water-Resources-Allocation-Israel.pdf [Accessed July 2017].

11. Water Technology Net. (undated) *Ashkelon, Israel*. Available from: http://www.water-technology.net/projects/israel/ [Accessed July 2017].

12. Water Technology Net. (undated) *Hadera Desalination Plant, Israel*. Available from: http://www.water-technology.net/projects/hadera-desalination/ [Accessed July 2017].

13. Water Technology Net. (undated) *Sorek Desalination Plant, Israel*. Available from: http://www.water-technology.net/projects/sorek-desalination-plant/ [Accessed July 2017].

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