



Research Office  
Legislative Council Secretariat

## Fact Sheet

# Seawater desalination in Singapore

FS09/14-15

## 1. Introduction

1.1 Singapore is a water scarce country. With a total land area of 718 sq km and a population of 5.5 million, the country does not have natural lakes, large rivers or substantial groundwater resources for fresh water supply. Singapore has been dependent on imported water from Malaysia, rendering its need for a diversified water supply management strategy. Over the years, it has devoted much effort to maximize local rainfall collection and explore new water resources to assure adequate and sustainable water supply.

1.2 On local rainfall collection, Singapore has built 17 reservoirs with the completion of two new reservoirs in 2011. It has also expanded the catchment areas to cover two-thirds of its total land area. As to new water sources, Singapore has built five NEWater plants to treat used water into high-purity water. At present, NEWater or reclaimed water can meet up to 30% of Singapore's current water consumption.<sup>1</sup> Apart from reclaimed water, Singapore has introduced desalinated water with the construction of two desalination plants that can currently meet up to 25% of the water consumption in Singapore. This fact sheet aims to provide the Panel on Development with information on the water supply management in Singapore, with special reference to the development of seawater desalination plants in recent years.

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<sup>1</sup> NEWater is mainly used for industrial and air-conditioning cooling purposes at semiconductor chip fabrication plants, industrial estates and commercial buildings. During dry periods, NEWater is added to reservoirs to blend with raw water.

## 2. Water supply management in Singapore

2.1 In Singapore, the Public Utilities Board ("PUB") is a statutory board established under the Ministry of the Environment and Water Resources, tasked with managing the country's water supply, water catchment and sewerage in an integrated way. As the national water agency, PUB is specifically responsible for the collection, production, distribution and reclamation of water to ensure a sustainable and efficient water supply. PUB also plays a role in nurturing the water industry. Through its wholly-owned subsidiary, PUB Consultants Private Ltd, PUB collaborates with Singapore-based water companies in overseas projects ranging from infrastructure development to operation and maintenance of municipal systems in water supply.

2.2 Singapore initially sourced its fresh water supply from imported water from Malaysia<sup>2</sup> and rainfall water collected. Due to the concern over high dependence on imported water and the need for long-term water self-sufficiency, the Singapore government went ahead in 2002 with boosting local water provision capacity through constructing new reservoirs, increasing catchment areas, and diversifying the sources of water supply.

2.3 On diversifying the sources of water supply, Singapore has been investing in water reclamation and seawater desalination projects. It built the first NEWater and desalination plants as early as in 2003 and 2005 respectively. After a decade or so of development, Singapore has built a diversified water supply sourced from four different sources (i.e. the "Four National Taps"), comprising (a) water from local catchment areas, (b) imported water, (c) reclaimed water from five NEWater plants, and (d) desalinated water from two desalination plants. Among them, NEWater and desalinated water can meet up to 30% and 25% of Singapore's total water consumption respectively.

2.4 Looking ahead, PUB forecasts Singapore's daily water consumption to almost double by 2060. As such, the Singapore government plans to more than triple the NEWater capacity and ramp up desalination in the years ahead, with NEWater and desalinated water meeting up to 55% and 25% of Singapore's water consumption in 2060.

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<sup>2</sup> Singapore has been importing water from Johor of Malaysia under two bilateral agreements. The first agreement expired in August 2011 and the second will expire in 2061.

### 3. Seawater desalination plants in Singapore

3.1 Seawater desalination has been considered by the Singapore government as a viable source of fresh water supply as early as since the 1990s, but it was not adopted at that time due to the high production cost involved. Subsequent improvement in seawater desalination technologies, particularly the growing global popularity of the reverse osmosis technology, has helped lower the cost of process. This led to the introduction of seawater desalination in Singapore in the 2000s.

3.2 In September 2005, the first desalination plant – SingSpring Desalination Plant – started to operate in Tuas, an industrial zone located in the western part of Singapore. As part of its long-term plan to raise the desalination capacity, Singapore constructed a second desalination plant – Tuaspring Desalination Plant – in Tuas in 2011. The plant was opened in September 2013, being one of the largest reverse osmosis plants in the Southeast Asia region.

#### SingSpring Desalination Plant

3.3 The SingSpring Desalination Plant commenced operation in 2005 with a designed annual capacity of 50 million cubic metres ("cu m"). Desalinated water is produced from pre-treated seawater through the process of reverse osmosis using semi-permeable membranes.<sup>3</sup>

3.4 The SingSpring Destination Plant was the first water infrastructure project awarded by the Singapore government to the private sector under the public-private partnership approach. Through open tender, SingSpring Pte Ltd ("SingSpring")<sup>4</sup> was appointed to design, build, own and operate the plant, as well as arranging the project financing. Water produced by the SingSpring Destination Plant delivered to PUB for distribution to households and industries. Under the water purchase agreement between PUB and SingSpring, SingSpring is obliged to deliver desalinated water to PUB over a 20-year period from 2005 to 2025. The price of desalinated water in the first

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<sup>3</sup> See FS07/14-15 for details of the reverse osmosis technology.

<sup>4</sup> SingSpring is a Singapore-based, wholly-owned subsidiary of Hyflux. Hyflux is a global water solutions company operating reverse osmosis desalination plants in countries such as Singapore, China and Algeria.

year of delivery was set at S\$0.78 (HK\$3.64) per cu m.<sup>5</sup> Annual price adjustments for the subsequent years are subject to factors such as fuel price and rate of inflation.

### Tuaspring Desalination Plant

3.5 Singapore's second reverse osmosis desalination plant, the Tuaspring Desalination Plant, commenced operation in 2013. With a designed annual capacity of 116 million cu m, the Tuaspring Desalination Plant is one of the world's most energy-efficient large-scale desalination plants. It is equipped with a self-sufficient on-site power plant which provides a secure source of electricity supply for seawater desalination. Excess power is sold to the national power grid.

3.6 The Tuaspring Desalination Plant is PUB's another public-private partnership project, in which Tuaspring Pte Ltd ("Tuaspring")<sup>6</sup> has been appointed to design, build, own and operate the plant alongside the project financing arrangement. Under the water purchase agreement, Tuaspring is required to deliver desalinated water to PUB over a 25-year period from 2013 to 2038, with the price set at a low of S\$0.45 (HK\$2.79) per cu m in the first year of delivery.<sup>7,8</sup> Similar to that of the SingSpring Destination Plant, subsequent annual price adjustments of the Tuaspring Desalination Plant also take into account factors such as fuel price and rate of inflation.

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<sup>5</sup> The first-year delivery price, at HK\$3.64 per cu m, is much lower than the estimated production cost (HK\$12-13 per cu m) incurred by the desalination plant proposed to be constructed in Tseung Kwan O. Yet the former does not include the water distribution to end-users and customer service costs, while the latter is an all-inclusive cost. The Research Office has written to both the Ministry of the Environment and Water Resources of Singapore and PUB for information about the total production cost of desalinated water in Singapore. As at the publication of this fact sheet, the Ministry and PUB have not responded to the request.

<sup>6</sup> Singapore-based Tuaspring Pte Ltd is also owned by Hyflux.

<sup>7</sup> Probably reflecting its higher energy efficiency, the Tuaspring Desalination Plant charges a lower price than the SingSpring Desalination Plant.

<sup>8</sup> Similar to that of SingSpring Desalination Plant, the first-year delivery price of Tuaspring Desalination Plant does not include the water distribution to end-users and customer service costs.

### Construction of new desalination plants

3.7 To prepare for possible prolonged dry spells and periods of droughts in future, the Singapore government announced in early 2015 that it would construct a third desalination plant in Tuas.<sup>9</sup> It has also unveiled the plan to construct additional desalination plants in other parts of Singapore to meet the rising future water demand, which is expected to almost double by 2060.

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<sup>9</sup> See Parliament of Singapore (2015).

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