Growing Singapore’s Water Industry: From Water Scarcity to Global Hydrohub

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The Leadership Academy for Development (LAD) trains government officials and business leaders from developing countries to help the private sector be a constructive force for economic growth and development. It teaches carefully selected participants how to be effective reform leaders, promoting sound public policies in complex and contentious settings. LAD is a project of the Center on Democracy, Development and the Rule of Law, part of Stanford University’s Freeman Spogli Institute for International Studies, and is conducted in partnership with the Johns Hopkins School of Advanced International Studies. LAD gratefully acknowledges support from the Omidyar Network.
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Introduction

The year 2006 marked a critical point for Singapore’s ambition to become a global hydrohub. In July, the newly formed Research, Innovation and Enterprise Council (RIEC) met for the first time to identify new areas of economic growth that would boost Singapore’s long-term competitiveness. “Sustainable economic growth” was the new buzzword. The Prime Minister of Singapore, Lee Hsien Loong, chaired the 18-member high-powered council. Following the inaugural meeting, the council announced that the water and environment industry was one of three growth areas (along with biomedical sciences and interactive and digital media) that would propel the country’s economic growth in the 21st century. Explaining the decision to grow its water industry, Prime Minister Lee pointed out that Singapore’s decades of experience and investments to address domestic water shortages would be valuable elsewhere as water shortages worsened worldwide. The private sector was envisaged to play a key role in developing Singapore as a global hydrohub.

Private sector involvement in Singapore’s water industry was not a recent phenomenon. Since the 1950s, the Singapore Public Utilities Board (PUB) has contracted with private companies to undertake various projects, including building water catchment areas, designing and building water treatment plants, and collecting and transporting wastewater to treatment plants.

Following RIEC’s decision, the chief executive of PUB, Khoo Teng Chye, was concurrently appointed executive director of the newly-created Environment and Water Industry Program Office (EWI). Khoo would head the daily operations of EWI so that it would be able to leverage PUB resources and garner support from the Board. Khoo saw the broadening of PUB’s mission into promoting the water industry as a way to help grow PUB as an organization. Setting up an independent body like EWI would help resolve what Khoo saw as a potential conflict of interest in PUB’s expanded role. The PUB is a statutory board, government-linked. The PUB would not just be a buyer of water technologies but would also award desalination and water recycling contracts to private companies. EWI would take over some of the responsibilities to promote Singapore as a global hydrohub that would have fallen to PUB.

RIEC had originally considered setting up a separate statutory board to grow Singapore as a global hydrohub, but ultimately decided that this was unnecessary and would be more complicated since it would require parliamentary legislation. Instead, the Council ultimately settled on creating a lean and nimble inter-agency body made up of seconded staff from various government bodies and research centers. Originally created by the Ministry of Environment and Water Resources, EWI was placed administratively under and housed with PUB. However, it was an independent body reporting to a steering committee led by Dr. Tony Tan.
**The challenge**

In an upcoming briefing of RIEC, EWI needs to address a number of issues regarding ways to keep Singapore’s water companies competitive. The key issue is the level of support the government provides to local water companies going forward. Should the government fund research and development in universities and research centers, or should it give direct assistance to local companies? In the latter case, will this stifle private sector initiative? EWI has to carefully consider whether local water companies are ready to stand on their own. Cutting government support too early or too late could have deleterious effects on Singapore’s global hydrohub ambitions.

EWI also needs to address how it could help local small and medium-sized enterprises (SMEs) face growing competition in the global water market. EWI is considering various initiatives, including trade missions and the construction of eco-cities overseas, which would provide opportunities for local water companies to gain a foothold in these markets. These government-led initiatives would provide a degree of protection for Singapore’s water companies, giving them time to understand and adapt to practices in these new markets. As before, however, EWI must consider how to provide sufficient assistance without interfering excessively.

**Background**

Singapore is a small island covering only 700 square kilometers, with a population of about 5 million people of Chinese, Malay, Indian and Eurasian descent. Given a low fertility rate (1.09 children per woman in 2009), the country has policies in place to increase its population by attracting talented foreigners. A former British colony, Singapore was part of the Federation of Malaya and then Malaysia until it left Malaysia in 1965. Singapore has a unique form of authoritarian government, with a parliamentary democracy dominated by the People’s Action Party (PAP), which has been in power since 1959. The government has played a central role in transforming Singapore from a tiny island without any natural endowments – aside from being well placed geographically such that it could develop a first-class global port – into the economic powerhouse it is today. Singapore is geographically well placed, along the Straits of Malacca, which allowed it to build a port to serve ships passing through the Straits. The creation of an uncrupt and efficient civil service was also a major factor in Singapore’s success.

Given the lack of an agricultural base, industry, commerce and households are the main consumers of water in Singapore. Average rainfall is 2,400 mm annually, well above the global average of 1,050 mm per year. However, the UN classifies Singapore as water scarce because its limited land mass imposes severe limits on its ability to capture and store water. Singapore’s growing population and rapid economic growth also exert pressure on land use, as water catchment areas have to compete for open land with housing, industry, transportation, schools, and recreation. Water scarcity threatens Singapore’s national survival and could seriously limit its long-term economic growth.
Historically, Singapore has depended on local catchments and water imported via pipelines from its northern neighbor Malaysia. Water negotiations and arrangements between Singapore and Malaysia date back to 1927 when the first agreement was signed between what were then two British colonies. Water agreements signed in 1961 and 1962 were incorporated into the separation agreement between Singapore and Malaysia. Under these two water agreements, Singapore buys raw water from the Johor state of Malaysia until 2011 and 2061, respectively, and sells treated water back to Johor.

Relations between the two countries are close but tense for historical reasons, including the nature of their separation, ethnic and religious issues, and economic competition. From time to time, Malaysia threatens to cut off water deliveries in order to exert political pressure on Singapore. In early 1997, for example, in response to a host of bilateral issues, including water, the head of the youth wing of Malaysia’s ruling party urged the government to review the basis of the water agreements with Singapore. The Chief Minister of Johor went even further, suggesting that Malaysia should appropriate two of the water purification plants in Johor operated by Singapore. These threats and the acrimonious negotiations over the water agreements exposed Singapore’s vulnerability, and led its government to accelerate the country’s drive to attain water self-sufficiency.

Negotiations to extend the water agreements with Malaysia were complicated, centering on the price of water but also covering other issues Malaysia hoped to resolve together with the water issue. In July 2002, Singapore indicated that it would allow the 1961 agreement to lapse in 2011, while reducing reliance on imported water.

The government of Singapore has long recognized the importance of the water issue. A Water Planning Unit was set up under the prime minister’s office in 1971 to study the scope and feasibility of new conventional sources such as unprotected catchments, as well as unconventional sources like water reclamation and desalination. The Water Planning Unit’s first Water Master Plan, produced in 1972, outlined plans to develop local water resources in Singapore, including water from local catchments, recycled water, and desalinated water, to ensure a diversified and adequate supply of water for future needs. This plan has served as a blueprint for the long-term development of water resources in Singapore.

In 2002, the “Four National Taps” strategy was introduced, referring to imported water, local catchment sources, desalinated water and recycled water (branded as NEWater). Desalinated and recycled water have important roles in meeting long-term demand, the former as a primary source of water, and the latter providing a multiplier effect. And private sector participation in these areas is critical to Singapore’s plan to become a global hydrohub.

**Public Utilities Board (PUB)**

PUB has played a central role in developing Singapore’s water sector, and its practices and management style set it apart from other Asian water utilities. Most other utilities are rife with cronyism, lack skilled personnel, and suffer from overstaffing, poor management, low remuneration and corruption. By contrast, PUB offers competitive salaries, incentives and benefits packages. The salary and benefit packages are benchmarked against the civil service,
which in turn benchmarks against the private sector. Furthermore, its commitment to training its staff and policy of rewarding good performers both foster good organizational performance.

PUB also instills a strong anti-corruption culture by training its staff on codes of governance and conduct, and by implementing effective internal control processes, regular audits and strong and immediate sanctions for corruption. Unlike other Asian public utilities, PUB has a high level of autonomy and enjoys political and public support. It has its own board of directors, and water tariffs are structured to ensure cost recovery. As a result, PUB invariably appears in the top 5 percent of all the world’s urban water utilities in terms of performance. For example, 100 percent of Singapore’s population has access to drinking water and sanitation. Water that is unaccounted-for (presumably due to leakage and other factors) is only a small percentage of total production. Ron Advani, former Senior Vice President and Managing Director of the Asia Pacific region of CH2M HILL, one of the major environmental and water companies operating in Singapore, says that “PUB is a statutory board but run like the private sector.” PUB received the Stockholm Industry Water Prize in 2007 in recognition of its achievements in sustainable water management.

PUB’s uniqueness among Asian public utilities is a result of a combination of Singapore’s political system and institutions, as well as its political culture. When the PAP came into power in 1959, one of the first tasks it set out for itself was to rid the government of corruption. Lee Kuan Yew, Singapore’s founder and former prime minister, wrote that

“We made sure from the day we took office in June 1959 that every dollar in revenue would be properly accounted for and would reach the beneficiaries at the grass roots as one dollar, without being siphoned off along the way. So, from the very beginning we gave special attention to the areas where discretionary powers had been exploited for personal gain and sharpened the instruments that could prevent, detect, or deter such practices.”

The Corrupt Practices Investigation Bureau (CPIB), created under the British in 1952, was the principal body in charge of this task. In 1960, an outdated anti-corruption law from 1937 was strengthened and broadened. Amendments gave broad powers to investigators, and made it unnecessary to prove that the person who had accepted a bribe was in a position to carry out the favor in return.

PUB was formed in 1963 to provide electricity, water, and piped gas supplies. It was restructured in 1995, shedding its energy functions and becoming the national water agency overseeing all functions related to the water supply, used water and storm water management. This meant that the entire water cycle would be managed as a single system, from sourcing and distributing water to collecting and treating water to produce NEWater. To ensure that large-scale production of NEWater would be carried out efficiently, upstream water reclamation plants that supplied the water for purification into NEWater were integrated with PUB’s water department. The 1995 restructuring made it possible to build three NEWater plants in rapid succession in 2003 and 2004.

Water tariffs were restructured to reflect the higher cost of securing future water supplies, and were allowed to increase progressively from 1997 to 2000. This increased the income of
PUB, and thereby enabled it to fund not only operations and maintenance of existing systems, but also investments for future activities. In 2005, PUB tapped the financial markets for a S$400 million bond issue, the first in its history. That the PUB was able to tap the financial markets for investments is an indication of its excellent management and finances.

PUB not only supplies tap water to households and industries, but also generates demand for NEWater and desalinated water using appropriate pricing policies and incentives to encourage uptake. Along with increases in the price of tap water from 1997 to 2000, PUB made recycled water cheaper than tap water and provided cheap loans and tax deductions to companies using recycled water.

As a result of its autonomy and high level of political and public support, PUB has been able to carry out many innovative approaches to managing the water cycle. It uses the private sector extensively where it does not have special competence or competitive advantage in order to strive for the lowest cost alternative.

**Public-private partnerships for recycled and desalinated water**

The availability of new technology in the late 1990s helped Singapore achieve its goal of producing recycled water economically and efficiently. But this had not been a forgone conclusion. Singapore has experimented with water recycling since the 1970s. In 1974, the first water reclamation plant, a pilot project between the Ministry of Environment and PUB, was built to test various water treatment technologies, including reverse osmosis. The pilot study confirmed that high-quality drinking water could be produced from used water. However, technologies such as reverse osmosis membranes were in the early stages of development and therefore expensive. There were also doubts about the reliability of the technology. The plant was subsequently decommissioned.

Another opportunity arose in the late 1990s, when pilot tests and overseas research confirmed that membrane technologies had become more reliable and cheaper to operate and maintain. In 1998, Lee Ek Tieng, chairman of PUB, and Tan Gee Paw, permanent secretary of the Ministry of Environment, felt it was time to revisit the earlier water reclamation project. Given the tense bilateral relations between Malaysia and Singapore, this renewed push received political support from the Cabinet.

As a result of this push, two young engineers, one from PUB and the other from ENV, were sent on a study trip to the US. Their findings showed that water recycling was viable, and a study team was formed. This led to the construction of a dual-membrane demonstration plant in Bedok in May 2000. The reclaimed water from this plant was monitored regularly over two years, after which an expert panel gave it a clean bill of health in terms of quality and reliability. PUB involved the private sector even in this early stage of developing NEWater by awarding the contract to build the demonstration plant to CH2M HILL, a US-based company offering environmental and engineering consulting services worldwide. After this successful demonstration, PUB decided to collect, treat and reuse wastewater on a large scale. All wastewater is collected through the Deep Tunnel Sewerage System, and is then treated.

A significant step in the development of NEWater was the facilitation of private sector participation in NEWater supply through the adoption of a public-private partnership approach
for subsequent NEWater plants. The private sector would design, build, own and operate the NEWater plant, producing and supplying NEWater to PUB based on a tendered price. This would allow PUB to focus on acquiring private sector services at a given level of quality at the most cost-effective price. Such an approach would encourage greater innovation to enhance production and operational efficiency, and in the longer term would help develop the water industry into a more vibrant, innovative and export-oriented sector. Reflecting on Hyflux’s initial years, Foo Hee Kiang, Group Executive Vice President of Commercial Contracts and Industry Relations, said, “PUB was forward looking, willing to trust small local companies even if we did not then had impressive track records.”

Expanding the use of recycled water was not based on groundbreaking technology. Rather, said Chief Executive of PUB Khoo Teng Chye, “What attracted a lot of attention was the way we marketed NEWater, branding it, setting up a NEWater visitor center, and persuading the population that it is drinkable.”

Desalination on a large scale also facilitated private sector participation in Singapore’s water industry. Similar to water recycling, desalination was considered as early as the first Water Master Plan in 1972. However, although the technology for desalination was effective it was also energy-intensive and costly. In the 1990s, advances in membrane technology significantly increased the effectiveness and reliability of desalination. Also, costs went down as use of membranes became more widespread. Desalination thus became economically feasible and the decision was made to implement desalination on a massive scale. In late 2005, the Tuas Desalination Plant, the first municipal-scale desalination plant, was opened at a cost of S$200 million.

While ceding greater control to the private sector, the Singapore government worked to enhance regulations to monitor the activities and standards of water companies. For instance, contracts were structured to ensure that the quantity and quality of the water supplied met standards. Design, build, own and operate agreements included clauses to impose penalties for non-performance, such as for maintaining inadequate production capacity or emergency water storage capacity. Other measures to mitigate potential problems with service continuity included “step-in” provisions in the event the concession company failed or was in default. PUB was authorized to step in and manage the concessionaire’s staff or equipment, or allow private financiers to identify other potential service providers that could take over operations. In addition, a comprehensive monitoring and audit system was put in place for all projects, in order to allow PUB to regularly check water quality and plant operation and maintenance. This included linking plants’ key online water quality monitoring systems to PUB’s monitoring systems, and having water sampled and analyzed regularly at accredited laboratories.

To the government of Singapore, public-private partnerships were not just about reaping efficiency gains. They were valuable opportunities for private companies to interact with government agencies over an extended period of time, with each party tapping the other’s amassed expertise and experience. Recounting his experience managing the NEWater demonstration plant in 1998, Ron Advani said that PUB was very eager to learn from CH2M HILL’s experience, and CH2M HILL played a significant role in shaping PUB’s thinking on NEWater as a result. Similarly, Keppel, which won the bid for the Ulu Pandan NEWater plant, had invited PUB to be actively involved from the design and construction phase. In fact, Keppel
attached its plant manager and operators to PUB’s Bedok NEWater factory for on-the-job training. PUB also invited Keppel’s staff to attend in-house training courses to build capacity in the construction, commissioning, and operation of NEWater factories. This unusually close collaboration with its partners helped the industry build up technical expertise and process know-how. The government benefited by ensuring that services outsourced to the private sector were reliable and efficient.

Environmental and Water Industry Program Office

RIEC decided in July 2006 to leverage Singapore’s expertise and experience in dealing with water problems and turn Singapore into a global hydrohub. EWI was set up to build on the expertise of the PUB, and promote – rather than merely regulating – private sector development of water infrastructure. It is responsible for spearheading the development of the water industry in Singapore in three core areas:

1. **Cluster Development.** EWI develops and executes plans to attract companies to locate their research, headquarters, and manufacturing operations in Singapore, and groom local companies to become world-class “champions”. EWI supports water companies’ research activities through the Incentive for Research and Innovation Scheme (IRIS) and Innovation Development Scheme (IDS). IRIS supports fundamental research while IDS funds applied research.

2. **Technology Development.** EWI encourages water companies and research institutions to research and develop cutting-edge water technologies. EWI adopted three schemes to ensure a steady stream of specialized manpower and high-quality research: graduate and joint company scholarships, visiting professors program and setting up centers of excellence in selected water domains to groom local expertise in these fields.

3. **Internationalization.** EWI facilitates exports of the products and services of Singapore-based companies to overseas markets, leveraging government-to-government initiatives. An example would be Keppel’s involvement in the China-Singapore Eco-city project at Tianjin. EWI, along with other government bodies, also regularly conducts trade missions and holds international conferences like the Singapore International Water Week, a forum for foreign and local businesses focused on water solutions.

Strategies and Policies

In 2006, as Khoo and his staff at EWI pondered the way forward for Singapore’s water industry, key considerations were how best to leverage on the private sector and what form that participation should take. One issue was whether the water supply industry should be restructured like the electricity supply industry, to create competition in the market with separate water suppliers feeding into a national grid.
Another key issue was how to lower or minimize risks so that the private sector would be encouraged to participate in the water industry. Water companies in Singapore were mostly young SMEs facing fairly high levels of risk. In the case of NEWater, not only was there risk that industry players and consumers would refuse to use reclaimed water, there was also technology risk in implementing the project, as the NEWater production process was still in its infancy. The downside to the government’s assumption of private sector risk was the possibility that this would encourage poor investments and long-term dependence on the government.

Finally, there was also the question of whether local companies could operate outside of Singapore. The country’s regulatory system and processes for awarding government contracts are straightforward, and the open bidding system is very transparent. There is no place for influence or corruption. Singapore’s transparent approach and tech-savvy bureaucracy are what draws well-established global water companies there. But would local companies be able to compete in environments with high levels of corruption and low technical expertise?

Conclusion

The government of Singapore has chosen an opportune time to develop its water industry. The global water industry is poised for future growth, as shown by the fact that it is one of the few sectors in the global economy that has been relatively unaffected by the global economic recession. In 1995, 5 percent of the world’s population was served by the private sector. By 2006, this has increased to 10 percent and is estimated to be at 12 percent in 2009. By 2015, 16 percent of the world’s population is expected to be served by the private sector. This is set to increase to 20 percent by 2025. Moreover, there are indications that the sector has become more diverse. Although large multinational corporations continue to dominate the global market, there are signs that space is opening up for smaller players, which have already begun to capture market share.

While Singapore’s plan to increase private sector participation in the water industry has been successful thus far, challenges lie ahead. For one, with the retreat of dominant multinational corporations, there has been an increase in the quality and quantity of smaller companies entering the water market. Although the diminishing role of the multinational corporations creates room for the growth of Singapore’s small and medium-sized enterprises, they now have to face increasing competition from smaller players from abroad. While bigger companies like Hyflux, SembCorp and Keppel already operate internationally, Singapore’s water SMEs typically do not. For Singapore to become a truly global hydrohub, its SMEs need to develop access to external markets well as the ability to survive in an increasingly competitive international market.

Singapore companies also face challenges that beset companies in the water industry in general. Water is often a source of conflict between states and within states. Private sector participation in the water sector tends to exacerbate these conflicts as debates rage over whether water is a public good or an economic good. According to the World Bank, 60 out of 662 contracts identified globally, or 34 percent of contracts in terms of total investment, were either canceled or in distress in 2008, compared with 4-8 percent for telecoms, electricity and transportation. Reasons range from regime change and political pressures from interest groups
and NGOs to disputes over performance delivery. Water companies also often operate in weak regulatory environments lacking strict separation of roles for the public and private sectors, and where contract law is unclear or underdeveloped. Singapore’s water companies, which are accustomed to operating in an environment where business regulations are clear and where water management is not subject to pressures from interest groups, operating in less straightforward legal environments will be difficult. Singapore’s government must help them prepare for this challenge.

Another challenge facing Singapore’s water industry is how to encourage water companies and research institutions to research and develop cutting-edge water technologies. There is still little private sector involvement in cutting-edge research and development, which is mostly confined to universities. Although some local water companies like Hyflux have established their own research centers, global water companies like Siemens invest a lot of resources in research and development. Local water companies, on the other hand, are mainly still at the stage of acquiring and improving on existing technology.

Finally, the overarching issue confronting Singapore’s government as it seeks to develop the private sector is the need to guard against local water companies becoming overly reliant on government initiatives, aid, schemes and funds, particularly in the area of research and development. The danger is that over-reliance on the government could stifle private sector initiative and creativity as the water industry matures.

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1 A global hydrohub is a global center for water technologies, expertise and management.
2 The Ministry of Environment was renamed Ministry of Environment and Water Resources on September 1, 2004, to reflect its expanded mission managing water as a national strategic resource.
3 Recycled or reclaimed water is wastewater that has been treated to remove impurities and solids.
5 Pinsent Masons Water Yearbook 2009-2010, p.xiii.
6 Ibid.