

Can water be a hot new fad? In Singapore it can, even though — or because — the liquid in the small “NEWater” bottles is in fact ordinary, unadulterated H<sub>2</sub>O. The Prime Minister drinks it and serves it to state guests, and the Public Utilities Board (PUB), Singapore’s national water agency, gets frequent calls from citizens who would like to receive a regular supply. Although NEWater wasn’t designed for retail trade, their wishes are granted. “During the last three years, we have distributed five million NEWater bottles,” says PUB’s Director for Water Supply facilities Lim Chiow Giap. The drink is a typical success story that’s almost as astounding as that of the city-state. NEWater really is *new* water because it used to be wastewater, but modern technology — made by Siemens — has transformed it into pure drinking water.

The water purification plant in the Kranji area — built in 2002 by Siemens Water Technologies (back then USFilter), which is part of the Industrial Solutions and Services Group — is one of the many future-oriented infrastructure projects that have made Singapore one of the world’s most dynamic and prosperous cities.

When it gained independence, this former British crown colony had no industry, raw materials or know-how. But farsighted economic planning and bold investments in education, research, healthcare, urban development and the environment have made Singapore into a global city that is home to 6,000 multinational firms and 500 financial institutes in an area only half as large as London. “We’re a small island with only four million people, so



*By teaming up with global companies and investing in education and state-of-the-art infrastructures, Singapore has become one of the world’s most dynamic cities. Other countries hope to learn from its experiences.*

# Singapore – Paradigm for a High-Tech Future

we have to invest in the most advanced infrastructure and technology. Top international companies like Siemens have played a key role in this development,” says Dr. Tony Tan, one of the architects of Singapore’s forty-year path-of-progress from the Third World into the First (see interview on page 24).

Driven by necessity, Singapore has developed and implemented concepts that point the way toward the city of the future. To protect its citizens from traffic congestion and smog, Singapore installed a fully automatic toll system for the city center in the early



1990s. “Before London set up its toll collection system last year, its traffic officials took a long look at our system,” says Eng Sok Yong, Group Director Policy and Planning at the Land Transport Authority (LTA). To cope with the problem of waste disposal, the city is building an extensive underground tunnel system to transport waste out of the city. “This is a high-tech solution, but hygiene is very important for us here in Singapore,” says Ooi Giok Ling, a professor of urban planning at Nanyang Technological University.

Singapore, a telecommunications leader, is already into its third generation of mobile communications, with the networks of three operators covering 95 percent of the city. The city is also spearheading the development of RFID (Radio Frequency Identification) systems, which can be used, for instance, to monitor the location of a shipping container anywhere in the world. “New technologies are often first introduced in Singapore because the city is so compact and its people appreciate telecommunications,” says Dr. Tan Geok Leng, Chief Technology Officer and Senior Director at the Infocomm Development Authority (IDA). “That means we have to deal with all the starting-up problems — but we also benefit from being the ones who solve them.”

**Recycling Wastewater.** One of the largest challenges Singapore has had to deal with is its water supply. Rainwater and groundwater cover only half of its needs; the rest is imported from neighboring Malaysia. That dependence caused Singapore’s government some concern — until Siemens helped it to discover a new source in the form of recycled water. “Of course many people need to get

results that construction of a major water purification plant was commissioned before the end of the test phase. Previously, the sewage plant in Kranji had used conventional methods and channeled the wastewater into the sea. Today, 40,000 cubic meters of drinking water are produced here every day.

NEWater’s visitors’ center welcomes Singaporeans who want to find out how it all works. “From the very start, we wanted to inform people,” says Lim. “This approach has helped to make NEWater acceptable.” Wastewater is purified in three steps. First, the treated wastewater is pumped through millions of tiny straw-like fibers with pores only 0.2 micrometers in diameter. This process traps all the suspended particles, such as dust and bacteria (*Pictures of the Future*, Spring 2005). Every 25 minutes these microfilters are cleaned, with the residue being loosened by an air current and then flushed away.

In the second step, water molecules are cleaned at high pressure by reverse osmosis (RO). RO membranes are so small that their pores allow only water molecule to pass. Dissolved pollutants such as pesticides and salts are removed. In a third step, the water, which is already extremely pure, is disinfected by means of ultraviolet radiation. The end product easily measures up to the standards set by the World Health Organization (WHO) and the U.S. Environmental Protection Agency (EPA). In fact, it’s almost a shame to simply drink it. Except for the bottles that fans receive, only one percent of NEWater is channeled into the drinking water reservoirs. The rest goes to industries that need extremely pure water for the manufacture of products such as semiconductors. As a result of its success, the water purifica-

tion plant in Kranji is now being expanded. By 2012, its capacity will be boosted to 210,000 cubic meters per day in order to meet 20 percent of the city’s water requirements.

**Power Plants and Medical Technology.** “Singapore is living proof that high-tech infrastructure solutions are an outstanding investment,” says Hans-Dieter Bott, Managing Director of Siemens Pte Ltd in Singapore, which has 2,000 employees in 11 business areas in the city state. To date, the company has invested more than US \$440 million in factories, research institutes and the construction of the Siemens Center, which opened in 2004. In addition to NEWater, the company has also provided the technology and know-how for many other infrastructure projects. For example, the gas turbines in Senoko, one of Singapore’s most modern



Be it the container port (at left) or traffic and environmental protection (above), Singapore is putting its faith in high-tech solutions. For example, Siemens technology is helping to transform wastewater into pure drinking water, while the city-state’s pioneering, fully automatic toll system is helping to cut traffic volumes and reduce smog.

used to the idea of drinking recycled wastewater,” says Dan Powell, Director of Operations at Siemens Water Technologies in Singapore. “That’s why a lot of PR work was necessary when we started out.” Government officials, for example, wanted to see for themselves whether the technology could deliver what it promised. In 1999 they commissioned USFilter to build a demonstration plant capable of producing 10,000 cubic meters of drinking water a day. The plan called for scientists to test the water quality for two years, but city planners were so impressed by the early

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Indeed, additional expansion is possible because the recycling process is cost-effective and much cheaper than other water purification methods such as desalination. So it’s no wonder that Kranji is hosting a steady stream of delegations from other Asian countries concerned about water resources. Nearby Thailand, for example, has pumped so much groundwater out of the earth in recent years

power stations, were manufactured by Siemens. So was half of the high-level diagnostic imaging equipment in the city's hospitals. What's more, Singapore is an attractive development and production location for Siemens — for instance, for hearing aids and, since 2005, the newest generation of automatic pick and place machines. "Singapore has an outstanding business environment, an excellent supplier base, and a highly trained and

Technology and Research (A\*STAR) is developing industrial applications and working with international firms to bring their applications to market. Singapore also wants to create a pool of experienced scientists that international companies can draw on. Some 2,000 researchers work in 12 institutes that report to A\*STAR. In 2004, Singapore generated 2.25 percent of its GDP through research and development, compared to 1.9 percent in the



**Drinking water made by Siemens. Every day, 40,000 cubic meters of wastewater are transformed into drinking water. Nanometer-sized pores filter out all pollutants.**

motivated labor pool that speaks English," says Bott. "It's the ideal business location!"

To stay attractive, Singapore is investing billions of dollars in future-oriented technologies, such as information and communication, chemicals, nanotechnology, genetic engineering and biomedicine. Several organizations are laying the groundwork for this. The National Research Foundation primarily promotes academic research and international cooperation. For example, in January 2006 the National University of Singapore (NUS) joined with nine other top international universities — among them Oxford, Cambridge and MIT — to establish an exclusive scientific association that will conduct joint research and organize student exchange programs. In parallel, the Agency for Science,

EU and 2.6 percent in the U.S., and that percentage is expected to increase considerably.

**A Pictures of the Future Process.** Whether or not Singapore is successful depends on its choice of research projects. Vincent Soh, head of Planning & Operations at A\*STAR, and his colleagues went looking for methods for making reliable forecasts. They found what they were looking for in Munich — once again, at Siemens. The future-oriented studies that Siemens is carrying out using its Pictures of the Future processes may soon be adapted by A\*STAR for its own planning, for the benefit of Singapore and other cities. After all, many megacities are looking to Singapore in their search for solutions and their visions of tomorrow.

■ Bernhard Bartsch