



belgian
foreign trade agency



Clean Technology Sector

SINGAPORE

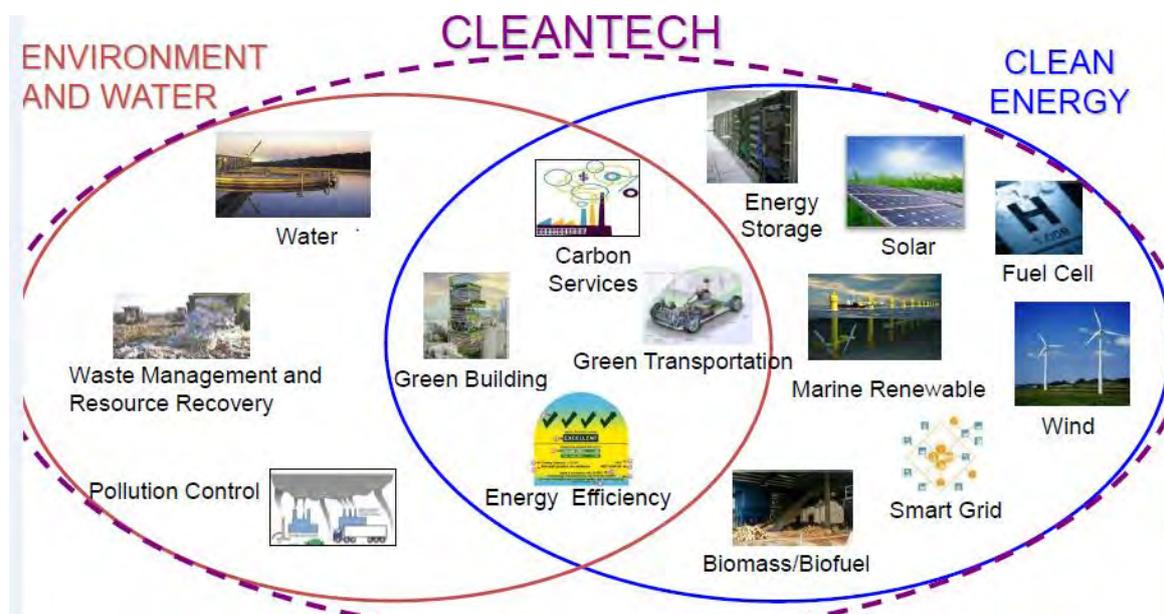
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1. OVERVIEW ON THE CLEAN TECHNOLOGY SECTOR IN SINGAPORE

Singapore has identified the “cleantech industry” as a strategic economic growth area and has placed great emphasis on its development, which includes the fields of clean energy, the environment and water, inter-related and capable of forming an ecosystem as a whole.



Source: Singapore Economic Development Board

The government of Singapore estimates that the cleantech sector will contribute S\$3,4 billion (€1,97 billion) to its gross domestic product (GDP) and employ 18.000 people by 2015.

1.1 CLEAN ENERGY SECTOR

Clean energy sector is an important sub-sector in the cleantech industry covering various areas from renewable energy such as solar energy, wind energy, biomass and tidal energy to energy savings, energy efficiency, carbon services, green buildings and transportation as well as intelligent energy system (smart grid)¹.

There has been a strong focus on solar energy, because of its geological location in the tropical sunbelt as well as its existing capabilities in semiconductor and electronics, precision engineering and chemicals industry.

¹ Cfr. III c

According to the Singapore Economic Development Board, it is expected that the clean energy sector will contribute S\$1,7 billion (€984 million) to its GDP while creating 7.000 jobs by 2015. In its Sustainable Singapore Blueprint launched in 2009, Singapore set the ambitious target for 80% of all its building to be certified as green buildings by 2030 and for its energy intensity to be improved by 35% by 2030.

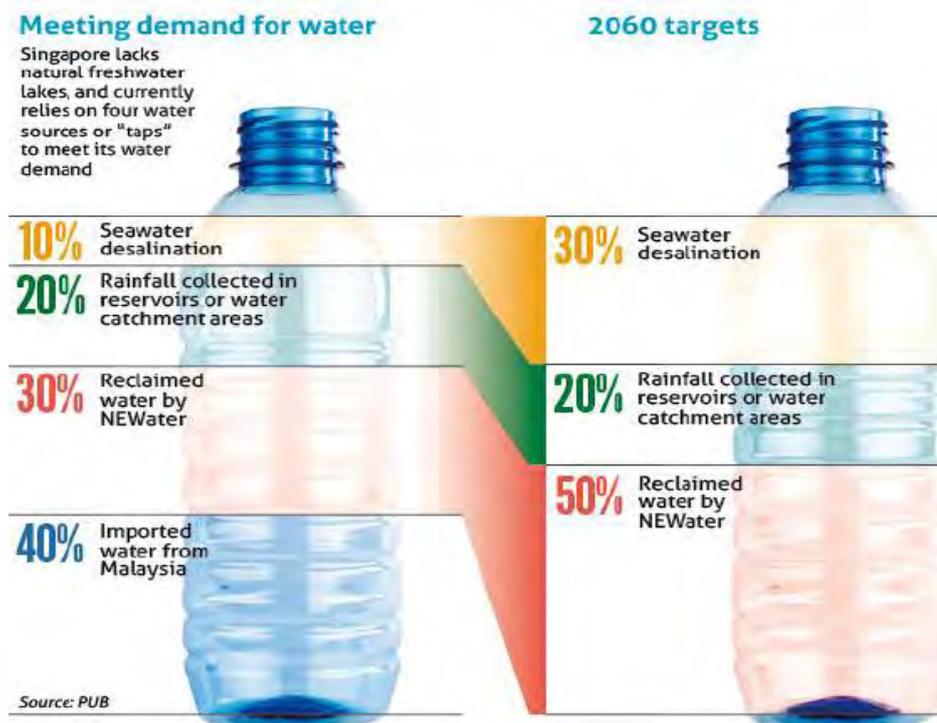
2.1 THE ENVIRONMENT AND WATER INDUSTRY

The environment and water industry is another major sector in cleantech industry and has also been identified as a key growth sector for Singapore's economy. Emphasis has been made on such areas as water treatment and wastewater recycling, solid waste management, resource recovery, as well as pollution control.

Singapore lacks natural freshwater lakes and currently relies on four water sources to meet its water demand: 40% of water imported from Malaysia, 30% reclaimed by NEWater², 20% rainfall collected in reservoirs or water catchment areas and 10% seawater desalination.

The government target for 2060 is to acquire 50% of water resource from reclaimed water by NEWater project, 30% from seawater desalination and 20% from rainfall collected in water catchment areas, namely to be self-sufficient.

The environment and water sector is expected to contribute S\$1,7 billion (€984 million) to Singapore's GDP and 11.000 jobs by 2015.



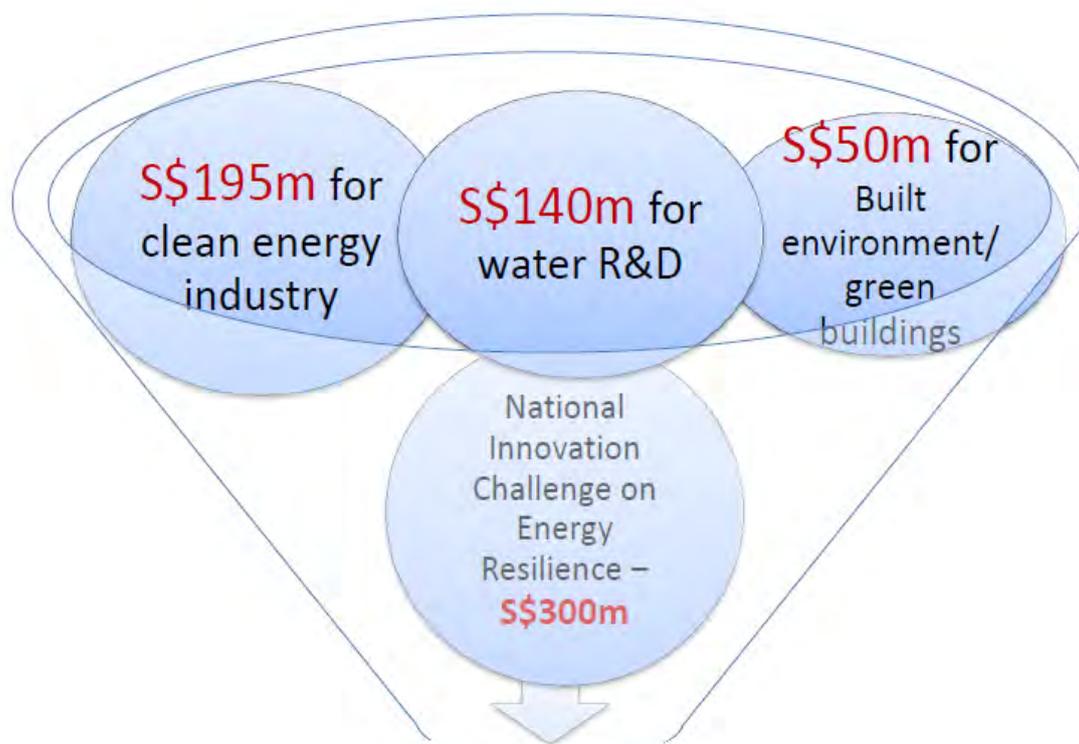
² NEWater is the brand name given to reclaimed potable water produced by Singapore's Public Utilities Board, Singapore's National Water Agency under the Ministry of the Environment and Water Resources

2. GOVERNMENT INVESTMENT

To accelerate the growth of the environmental industry and to maintain Singapore's image as a city in a garden, the government has initiated several funding and incentive schemes related to energy efficiency, clean energy, green buildings, water and environmental technologies, green transport and shipping, waste minimisation, energy and greenhouse gas management, and environmental initiatives and training. The five key pillars laid out by government development blueprint for cleantech sector consist of research & development, manpower development (scholarship program), grooming of Singapore-based enterprises, branding of the industry, and nurturing an industry eco-system.

STRONG GOVERNMENT INVESTMENT IN R&D

Between 2011 and 2012, the Singapore government announced more than S\$800 million (€463 million) of new public sector R&D funding to address energy, water, green buildings and land scarcity issues. Along with the R&D investments, the government is committed to grooming research talent in urban sustainability through postgraduate scholarships and specialized courses.



S\$700m (€405m) funding in mid-2011

Source: Singapore Economic Development Board

3. MARKET DEVELOPMENT

3.1 MARKET DEMAND

3.1.1 CLEAN ENERGY

In the clean energy sector, there have been a range of pilot projects launched: smart grids³, the cleantech park⁴, as well as a variety of solar projects such as the S\$11 million floating photovoltaic project on Tenggal Reservoir in the western part of Singapore.

According to a white paper released by the Sustainable Energy Association of Singapore (SEAS), Singapore's renewable energy market can make up to 10% of the country's energy demand by the year 2020. In contrast, only 1% of Singapore's energy consumption comes from renewable energy sources.

The market growth of renewable energy depends most on the investment of the private sector. Authorities therefore actively encourage investors to continue focusing on this field. The Energy Market Authority of Singapore adjusted its regulatory framework to make it accessible for renewable energy producers to sell their excess energy to the market. In particular, the registration process for renewable energy consumers selling their excess electricity to the national grid will be significantly simplified.

3.1.2 WATER INDUSTRY

Singapore has a well-developed water industry, but insufficient natural water resources. The World Resources Institute (WRI) classed Singapore as in the 'extreme' category of water stress - putting it on a par with arid nations such as Saudi Arabia and Kuwait. Evidence of this stress can be seen in the recent water shortages and threats of rationing which loomed in the first two months of 2014.

Water sustainability and security are priorities for Singapore's socio-economic growth. Singapore is committed to transforming itself from a country dependent on imports from Malaysia for 40% of its water resource into a self-sufficient one, especially when a major water agreement with its neighbor is due to expire in 2061.

Currently, Singapore uses two separate systems to collect rainwater and used water.

On one hand, the government of Singapore has been reinforcing its rainwater and stormwater harvesting initiatives for its water catchment system, with a range of recently introduced projects, both by the Public Utilities Board (PUB)⁵ and under Public-Private

³ Cfr. III c

⁴ Cfr. III c

⁵ Singapore's National Water Agency under the Ministry of the Environment and Water Resources

Partnerships. Rainwater is collected through a network of drains, canals, rivers and stormwater collection ponds before it is channelled to reservoirs for storage. By 2011, the water catchment area has increased from half to two-thirds of Singapore's land surface. PUB of Singapore aims to boost Singapore's water catchment area to 90% by 2060.

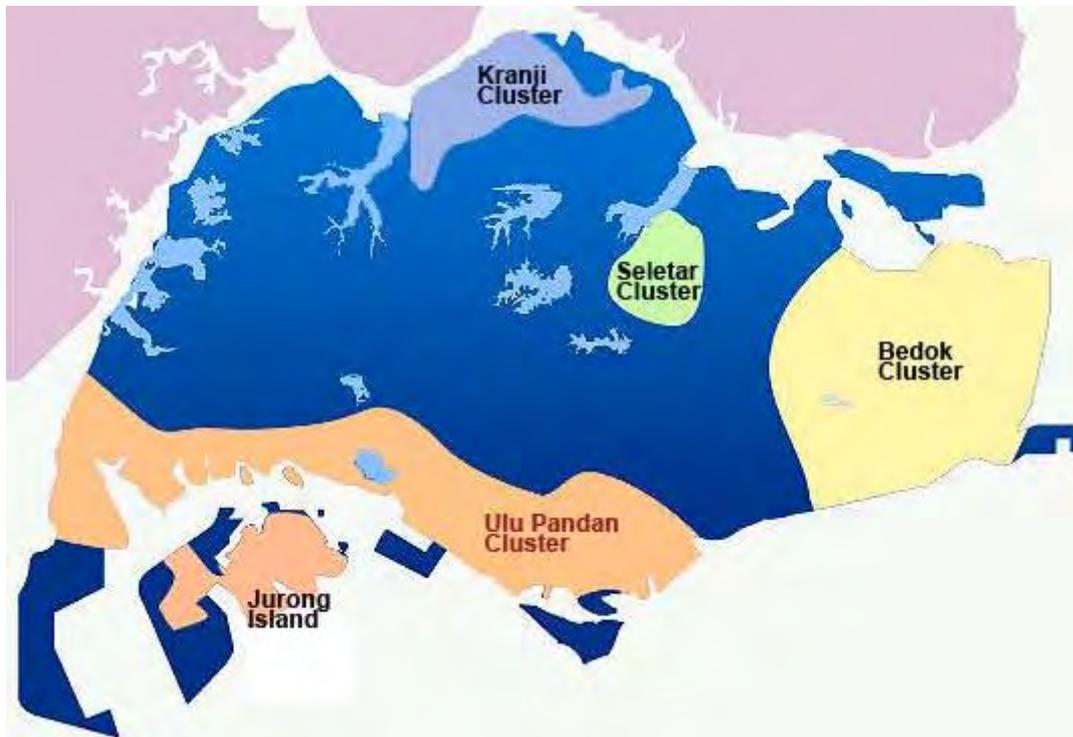
WATER CATCHMENT AREA IN SINGAPORE



Source: PUB of Singapore

On the other hand, NEWater plants for water reclamation has seen an expansion since the first one put in place in 2003, meeting 30% of its current water demand as mentioned earlier.

NEWATER PLANTS IN SINGAPORE



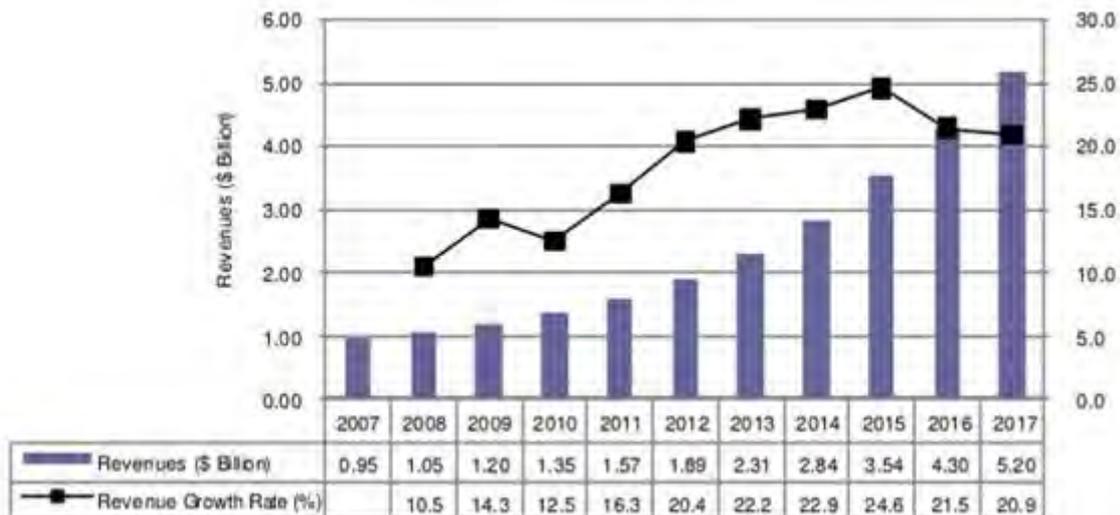
Source: PUB of Singapore

At industrial user level, the government of Singapore is encouraging industrial users to conserve and recycle water through, among others, legislation and economic incentives. Market prospects for industrial users are promising and future demand could be greater as Singapore's economy is expected to continue robust growth.

During the first decade of 2000, the Public Utilities Board, has outsourced some €2,2 billion worth of water infrastructure projects including the Deep Tunnel Sewerage Systems, Marina Barrage, NEWater facilities and desalination plants, to the private sector. As a result, the water conservation and recycling equipment market has been on the increase in parallel. As of the end of 2009, the domestic market size for water conservation and recycling systems was estimated at €689 million and is expanded by 10%-15% annually from 2010 to 2013.

The overall environment & water industry revenue of Singapore has also witnessed remarkable growth and this momentum will continue thanks largely to its internationalization strategy, benefiting from Chinese and Southeast Asian markets.

WATER AND WASTEWATER TREATMENT MARKET: REVENUE ESTIMATION FOR SINGAPORE, 2007-2017



Source: Frost&Sullivan

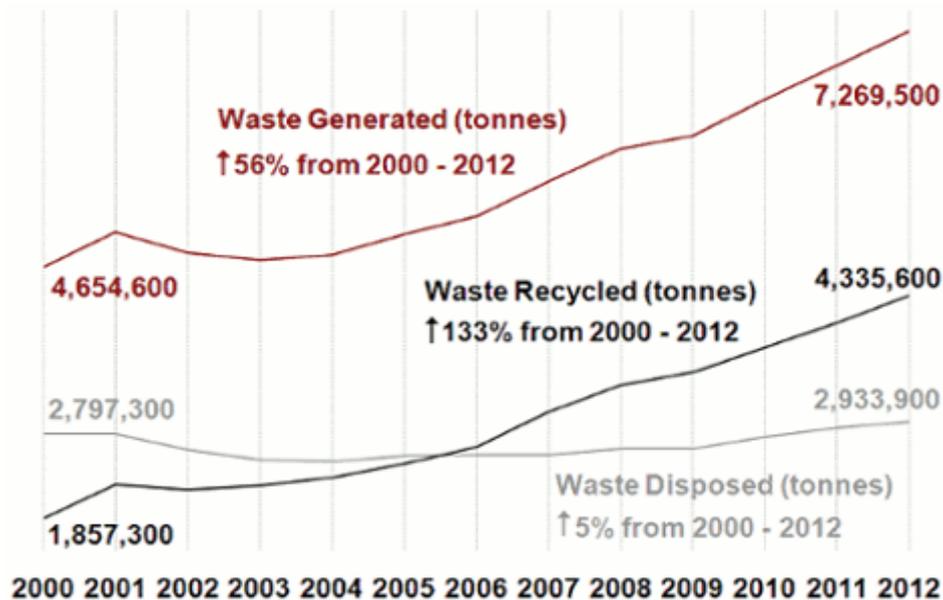
3.1.3 WASTE MANAGEMENT

As a highly urbanized and industrialized small island nation with a land area of 697 km² and a population of 4,2 million, Singapore is also building critical mass in the areas of waste management and recycling.

In 2012, about 7,3 million tonnes of waste was generated in Singapore, and each person generated around 1.370 kg of waste in a year. The recycling rate in Singapore for 2012 is

60%, while 40% of Singapore's waste is still disposed of, with 37% going to the waste-to-energy plants for incineration and energy recovery, and 3% of non-incinerable waste going to the Pulau Semakau, an island south of Singapore and its only landfill site, which is expected to be filled by 2016.

WASTE STATISTICS FROM 2000 TO 2012



Source: Singapore National Environmental Agency, ZEROWASTESG.COM

From 2000 to 2012, the total waste generated has increased by 56%, while the waste disposed has increased by 5%, with an increase of 133% for waste recycled.

The National Environment Agency (NEA) of Singapore has been working on the expansion project of at Pulau Semakau, namely the phase two, expected to be completed by early 2015. This will allow Singapore to meet projected waste disposal needs up to 2035 or beyond.

As such, waste management is one business growth area where Singapore requires good solutions, and where it can serve as a working model and a test bed for new ideas.

3.2 LEADING INDUSTRY PLAYERS

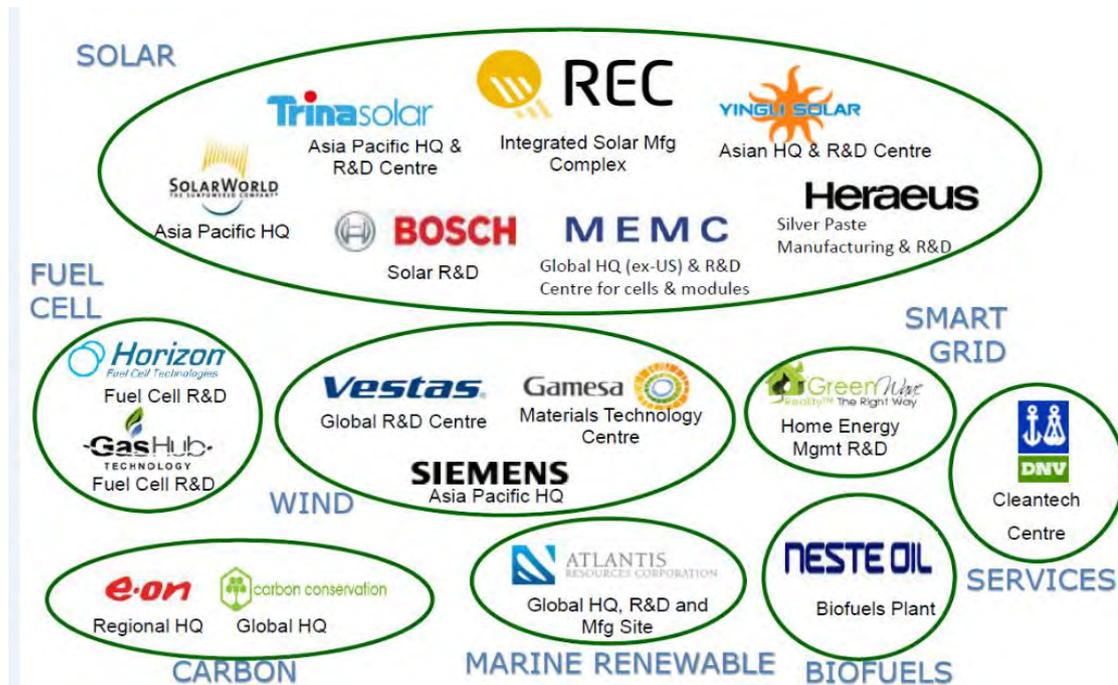
3.2.1 CLEAN ENERGY

Singapore's know-how in electronics, precision engineering and chemicals, together with its extensive supply chain, infrastructure and logistics capability, intellectual property protection regime and innovation as well as its connectivity with the Asian market render it an attractive market to clean energy companies.

Some of the leading industry players in clean energy sector of Singapore are as follows:

- **Atlantis Resources Corporation** (UK), one of the world's largest leading tidal energy companies, has established its global headquarters in Singapore;
- **China Guangdong Nuclear Power Holding Corporation** established its integrated biomass – solar power generation plant and set up regional headquarters for its renewable energy operations in Singapore
- **Vestas Wind Systems** (Denmark), the world's largest supplier of wind power systems, has chosen Singapore as the base for its largest R&D centre outside Denmark
- **Bosch** (Germany) announced that it is investing €15 million to conduct research in organic photovoltaic technology
- **DNV** (Norway), risk management service provider, has established a new Clean Technology Centre (CTC) for developing new cleantech services in technology qualification and certification, risk assessment, and asset management. its activities cover the following areas: clean energy; green shipping and offshore design; green ports; climate change adaptation; carbon market services; sustainable cities and urban solutions
- **Gamesa** (Spain), wind turbine manufacturer, has chosen Singapore as the base for its first R&D centre in Asia
- **GreenWave Reality** (US), a building energy management systems company, is developing the energy management software and hardware for smart grid applications and LED lighting
- **Phoenix Solar** (Germany), a photovoltaic solutions provider in PV system integration in Singapore and the region
- **Panasonic** (Japan): energy solutions R&D centre in Singapore; test and commercialise its "Total Energy Solution", involving the system integration of several clean energy components such as solar systems, lithium-ion batteries, home energy management systems and energy-efficient air conditioning in "Punggol Eco-Town"
- **Renewable Energy Corporation** (Norway): established one of the world's largest integrated solar manufacturing complexes in Singapore
- **Trina Solar** (China): collaboration with the Solar Energy Research Institute of Singapore to develop high-efficiency back-contact solar cells
- **Yingli Green Energy** (China): regional headquarters and R&D centre in Singapore

LEADING INDUSTRY PLAYERS IN CLEAN ENERGY SECTOR OF SINGAPORE



Source: Singapore Economic Development Board

3.2.2 ENVIRONMENT & WATER INDUSTRY

Today there are more than 100 water companies involved in activities spanning R&D, engineering and manufacturing to regional headquarters.

Some of the leading industry players in the environment and water industry include:

- **Siemens Centre of Competence for City Management** (Germany): responsible for designing, developing and implementing innovative urban technological solutions that can help cities improve their environment and quality of life.
- **Siemens Water Technologies** (Germany): Global Water Technology Research Centre specialized in products, systems and services for water and wastewater treatment; R&D project on low energy seawater desalination
- **E.ON**(Germany): creation of tradeable carbon emissions offsets
- **EDF** (France): design and planning of eco-towns
- **Veolia** (France): design and planning of eco-towns; waste management services aimed at both solid and liquid waste as well as both hazardous and non-hazardous waste; recyclables trading

- **Black & Veatch** (US): provide engineering design services and consultancy in the water industry
- **General Electric Water & Process Technologies** (US): establish a Global Water R&D Centre in such areas as water treatment and systems integration, fundamental chemical and membrane applications to ion-exchange technology
- **Marmom Water / KX Technologies** (US): provide carbon filtration technologies for residential water treatment applications
- **Pall Corporation** (US) fluid management company specialising in filtration, separation and purification technologies
- **Nitto Denko** (Japan): develop membrane technology for water reuse and desalination
- **Toray** (Japan): a R&D centre focused on water treatment technologies (advanced membrane technologies) in Singapore
- **Hyflux** (Singapore): membrane-based seawater desalination plant – largest in Asia - supply 10% of the country's water needs; joint R&D centre with Marmom Water LLC focusing on commercial and residential water products R&D
- **Keppel Corporation** (SG): environmental technology center to conduct R&D in water, wastewater, solid waste and waste-to-energy areas; 1MW (megawatt) PV system to supply solar energy for a waste water treatment plant
- **ECO** (SG): toxic and hazardous waste management, industrial and commercial waste managementn, industrial services, wastewater sludge treatment, laboratory services and R&D
- **Sembcorp** (SG): provide services including industrial water and wastewater treatment, water reclamation, and on-site logistics, collection, post-collection treatment and hazardous waste treatment

MAJOR ENVIRONMENT & WATER COMPANIES IN SINGAPORE



Source: Singapore Economic Development Board

3.3 EXPERIMENTAL CLEANTECH PROJECTS

When the business growth theme - Whole-of-Government (WOG) program, was launched in 2008, Singapore has positioned itself to serve as a “Living Laboratory”, making its national urban infrastructure available to local and international companies who find it useful to develop, test, prove and showcase their solutions in a real-life urban environment, after which companies can use Singapore as the springboard to export such solutions globally.

LARGE-SCALE INTEGRATED LIVING LABS IN SINGAPORE



Source: Singapore Economic Development Board

Some of its representative experimental projects are as follows:

- **Smart Grids:** an intelligent energy system dedicated to test smart grid technology equipment and determine how to best integrate other sources of power, such as solar energy, into the main grid, which is a high-tech network of intelligent meters that communicate with each other and allow consumers to optimize their power use
- **Cleantech Park:** committed to bring together clean technology corporations, public research institutes and laboratories to encourage collaboration, innovation as well as prototyping activities in one cluster. It will also achieve a low resource consumption, low waste, and low emissions footprint through green buildings, renewable energy and clean technologies. The first building at this Park was completed in early 2012.
- **Punggol Eco-Town:** Singapore's first public housing blocks built to be environmentally sustainable, serving as a test-bed for energy, water and waste management technologies
- **Pulau Ubin:** a test bed for harnessing electricity from a variety of renewable power source through intelligent power grids for an off-grid community
- **Jurong Island:** housing such projects as energy-from-waste plants, smart grid technologies and research facilities and clean coal plants

4. BUSINESS OPPORTUNITIES

There exists numerous business opportunities for:

- Equipment manufacturers
- Filtering and purifying machinery and apparatus
- Wastewater recycling and treatment technologies
- Modular wastewater treatment systems
- Intelligent charging infrastructures and management solution providers for electric vehicles
- Biotechnology company producing environmentally friendly products for the oil and gas
- Solar technology providers
- Eco-friendly building ventilation system suppliers
- Industrial dust collection technology suppliers
- Green building consultancy firms
- ...

5. USEFUL INFORMATION

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