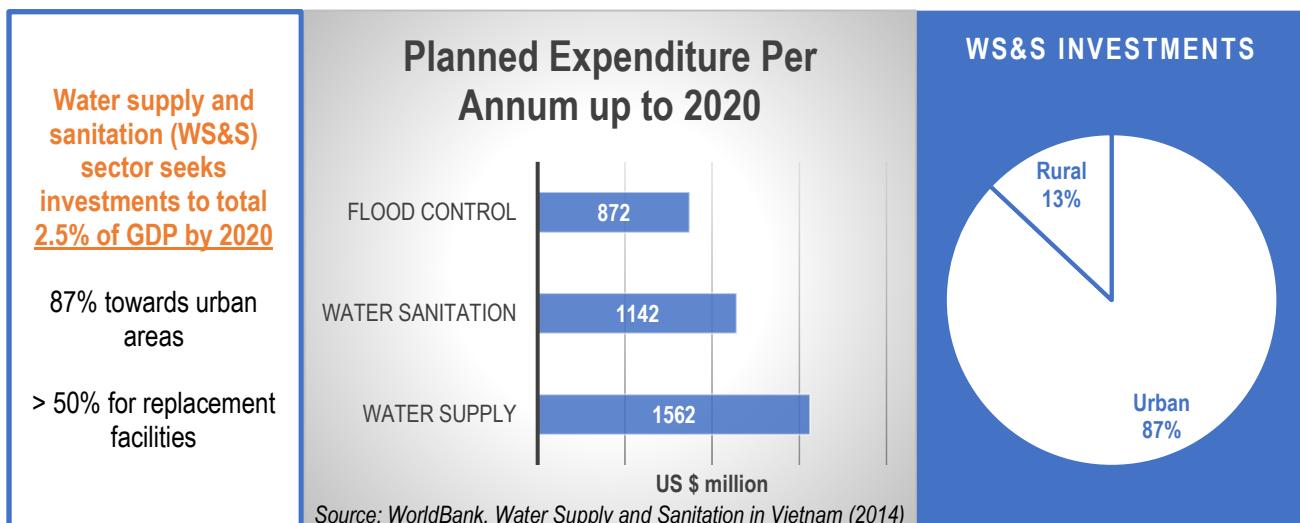
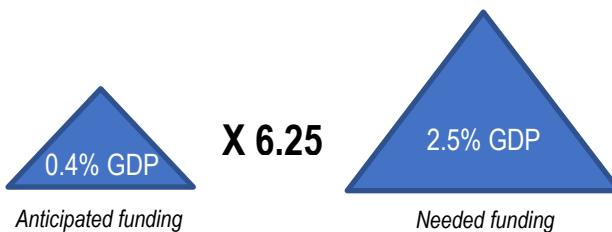


Vietnam's Water Sector Outlook and Engineering Opportunities

Water Sector Targets



Needed investment of 2.5% GDP by 2020 is ambitious considering an expected investment of 0.4% GDP (with growth rate of 0.2%/year) (World Bank 2014).



As per the Prime Minister's Decision 1929/QD-TTg on the "Orientation for Development of Water Supply in Vietnam's Urban Centres and Industrial Parks Leading to 2025, and Vision for 2050" and Decision 2147/QD-TTg on approval of the "National Unaccounted for Water and Nonrevenue Water Reduction Program to 2025".

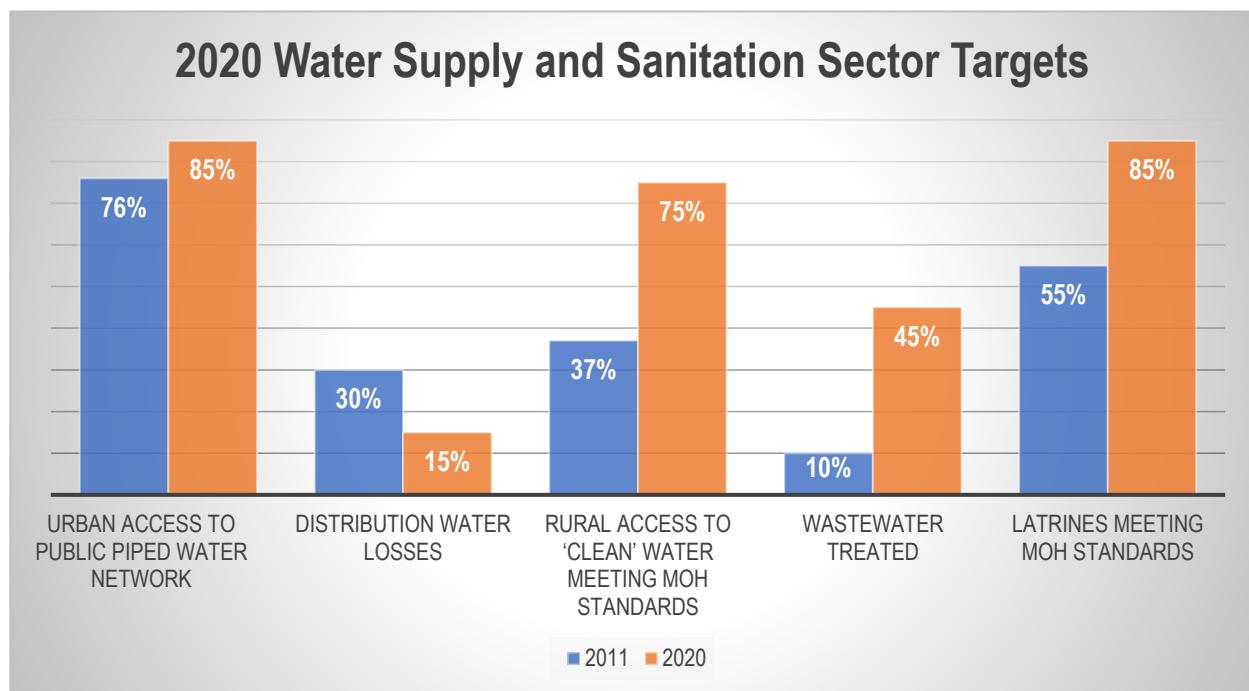
By 2025 most urban cities will have centralized municipal wastewater treatment and collection systems;

70-80% of municipal wastewater will be collected and treated properly.

By 2050, all urban cities class IV and above will have storm water discharge and wastewater treatment systems.

Ho Chi Minh City's Urban Flood Control Program, has a master plan for drainage system upgrades to 2020 amounting to **US\$4.36 billion from 2016 to 2020**. The plan includes the construction and upgrade of 6000km drains, 12 waste water treatment plants (WWTPs) and 5,075 kilometres of canals.

Despite this supposed commitment, priorities are often misconstrued. In May 2017 Thanh Hoa granted a 10-month wastewater discharge license to the Nghi Son Refinery & Petrochemical LLC (NSRP), the developer of the Nghi Son refinery.

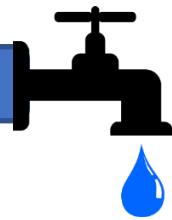


Sources: UNICEF and WHO Joint Monitoring Program (JMP) 2013, Ministry of Construction Unified Sanitation Sector Strategy and Action Plan 2012, Vietnam Water Supply and Sewerage Association 2011, Ministry of Agriculture and Rural

Water Sector Issues

- **Withdrawal of much ODA funding** as economic development has occurred, previously relied upon for water system upgrades. PPPs are now relied to engage investment from the private sector.
- **Low budgets** to meet low tariffs, leading to deteriorated service quality as low budgets provide insufficient capital and O&M.
- **State-owned utilities** require privitisation to attract foreign investments through independent economic regulation.
- **Unattractive tariffs** which do not provide significant incentive for water utility investment as cost recovery is low.
- **Utilities lack autonomy**, the ability to sustain a quality service, manage operations and undertake system developments.
- **Inadequate regulatory environment** of wastewater effluent and enforcement scheme.
- **Lack of congeniality** between Central and Provincial Government priorities, project commitment and tariff policies.
- **Unserviceable existing treatment technology** as water is becoming excessively polluted.
- **Rapid speed of economic development**, urbanisation and industrialisation which is not met by corresponding water supply and wastewater infrastructure.
- **Low capacity** of drainage systems and service provision.
- **Substandard quality** of water distribution piping networks and facilities which effects service efficiency and lifespan.
- **Over-exploitation and pollution of groundwater**, leading to health issues and land subsidence.
- **Limited surface water supply**; according to standards of the International Water Resources Association, the minimum surface water per capita should be 4,000m³/year whilst in Vietnam this is 3,850m³/year.

Subsector: Water Distribution Systems & Infrastructure



76% of the urban population have access to a public piped water supply network via a house connection or shared water point
(Ministry of Construction 2011)

37% of the rural population have access to 'clean' water meeting quality standards set by the Ministry of Health (Ministry of Agriculture and Rural Development 2011)

Water losses total to **30%** (equivalent to more than 1.8 million m³/day), peaking at 40% in some cities including Hanoi and HCM City
(Vietnam Water Supply and Sewerage Association)

<15% water sector investments have been directed at distribution improvement (World Bank 2014)

Total 79 water utilities with designed supply capacity of 5.9 million m³/day yet on operation capacity of 4.5 million m³/day, giving a **77% efficiency rate** (WHO 2011)

Vietnam's current water consumption of 80.6 billion m³ is predicted to **rise by 48%** by 2020. 10% of the population will suffer from water shortfall by 2050 (ADB)

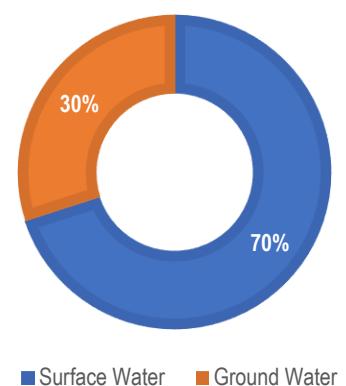
Water shortages are not uncommon, stemming from an increasing demand, poor water management practices and inadequate infrastructure. The impacts from hydropower dams, drought, saltwater intrusion and overexploitation of water resources also affect water availability. Proper water management including water storage facilities need to be prioritised for reasonable use during dry season.

Drainage infrastructure often does not follow quality requirements of the regulations. Hanoi's 10km long major pipeline from Da River started operation in 2009. From 2012 to 2015, the pipeline broke a total of 14 times, with businesses reliant on the project forced to spend over VND13 billion (US\$573,620) on fixing it. However, regulations also can prove inadequate.

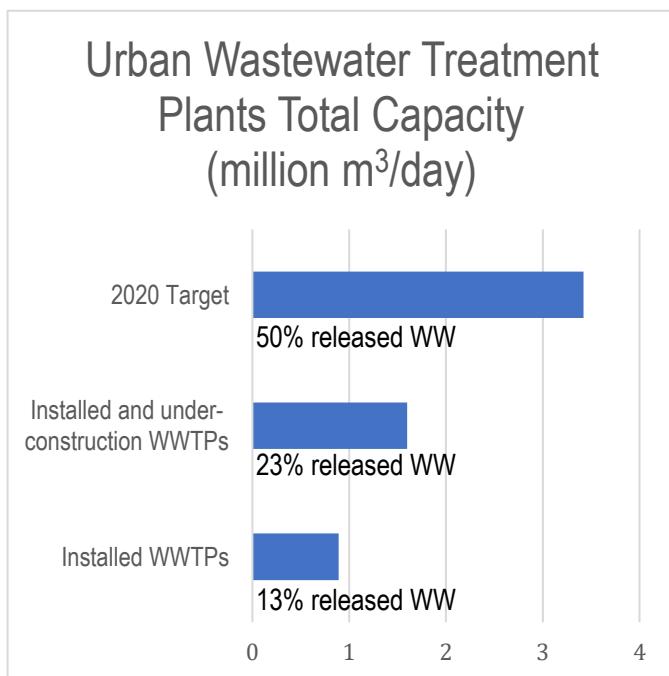
In April 2017 Thanh Da View Apartment Complex in Ho Chi Minh City was without water for nearly a fortnight due to insufficient water pumps and pipes, despite installation according to guidelines set by Gia Dinh Water Supply JSC.

Inadequate distribution systems mean treated wastewater is re-polluted during transportation from treatment facilities to point-of-use. In general, water quality at water treatment plants supplying water to urban areas meets the standards for drinking water (QCVN 01:2009/BYT issued by MoH) but rarely meets standards for domestic water at households (QCVN 02:2009/BYT).

WATER SUPPLY COMPOSITION



Subsector: Waste Water Systems & Infrastructure



Recently, the Hoa Binh sugar facility in Hoa Binh Province had to pay over US\$62,734 in compensation to fish farms damaged by the uncontrolled release of their non-treated wastewater into the river.

Dankia-Suoi Vang Lake, the water source relied upon by Dalat's residents, is infected with **E. coli 12 times the acceptable amount** plus levels of suspended solids and heavy metals 1.5 – 2 times greater than the allowed limit (Nuclear Research Institute of Da Lat, 2017). 6.3 million m³ treated annually from the lake now needs 10 times the volume of chemicals to safely treat the water, according to Lam Dong Water Company (LAWACO).

92% of wastewater in Vietnam is conveyed by combined sewerage systems (CSS). As municipal wastewaters and surface run-off are not separated, treatment efficiency and sludge management cannot be optimised.

The sludge generated from wastewater is a large environmental hazard. The Environmental Protection Agency (EPA) estimates that costs for effective sludge management represent approximately 50 percent of an operations and maintenance (O&M) budget for a wastewater treatment plant.

<10% of Vietnam's wastewater is treated

Vietnam's 37 urban wastewater treatment plants only have total capacity of 890,000 m³/day which is 13% of released wastewater (MoC 2016)

75% of industrial wastewater is being discharged into lakes and rivers without treatment, equal to 240,000 m³ daily (Ministry of Natural Resources and Environment)

A 2017 municipal People's Council report proved **19 of the 43** industrial zones in Hanoi do not have waste WWT plants, and from those that were operational only **50%** worked effectively

90% of households dispose wastewater to septic tanks, yet only **4%** of the septage is disposed satisfactorily (World Bank)



Subsector: Flood Control Infrastructure

Vietnam's geography and topography makes the nation highly prone to flooding. Flash flooding is particularly common during the rainy season due to high intensity rainfall and insufficient flood prevention planning and infrastructure. Urban water drainage facilities are incomprehensive, often run-down and of insufficient capacity as a consequence of rapid urbanisation. Further exacerbating issues, new developments encroach on storm water channels and canals.

Urban developments are prioritised before drainage. HCMC's Department of Transport supposedly protects over 900 storm drains, channels and canals. Despite this the Tran Thanh Real Estate Company was permitted by local authorities to partly replace and partly fill up (to build a road) a protected waterway, the Rach Dua Channel.

In August 2017, flash flooding in Northern Vietnam killed 26 people with an estimated damage of \$US43 million. In October 2016, 11 people died when the central province Quang Binh flooded.

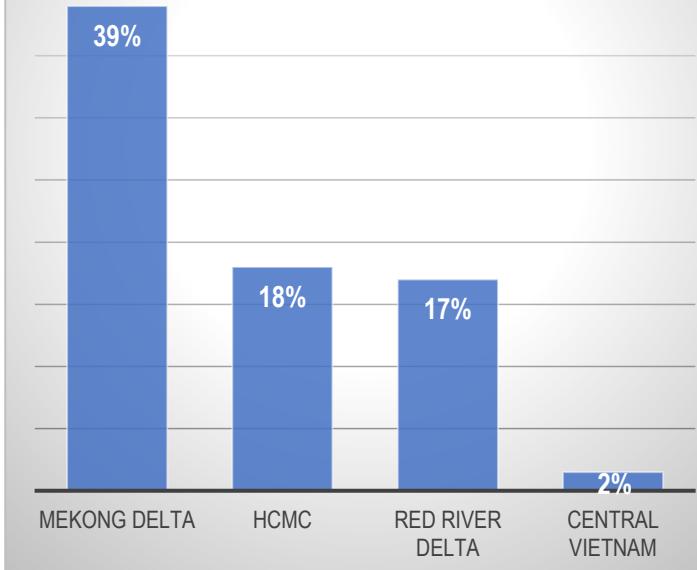
49% of HCM City's 110 channels and canals stretching 5km are non-serviceable due to blockages

HCMC is ranked the **4th** most vulnerable city to sea level rise as a % of GDP (Washington Post 2013)

With the predicted sea level rise of nearly 1 metre, Vietnam will face:
a loss of **\$17 billion/year**;
1/5 population will be homeless and
12.3% of farmland will disappear
(United Nations (UN))



UN Predicted Land Area Submergence (due to sea level rise by ~1m)



Recent Investments



Water Distribution Systems & Infrastructure

Saigon Water Corporation (SAWACO) received US\$160.36 million in August 2017 from Vietcombank and the HCM City Finance and Investment Company (HIFC) to finance HCMC's major water supply system upgrade across 11 projects. Since 2015, HIFC and Sawaco have worked together in 33 projects to build reservoirs and water pipes with a total capital of US\$145.2 million, of which HIFC contributed US\$107.4 million.

ABB (Switzerland), operating in the fields of robotics, power and automation technology, is cooperating with SAWACO to reduce daily water loss by 500,000m³ with a strategic control and monitoring system known as the ABB Ability Symphony Plus. The overall aim is to reduce leakage in HCMC to only 10% by 2020.

Aquaone and Duong River Surface Water JSC JV signed a Memorandum of Understanding with Hanoi to develop a clean water supply system in the city with an estimated investment sum of US\$227.27 million. The JV will have Maynilad, one of the leading water and wastewater services conglomerates in the Philippines, as a partner in these projects.

Asia Development Bank (ADB) approved a US\$1 billion plan in 2011 to improve access to clean water for more than 3 million Vietnamese households, 500,000 of which were to be connected to the public pipeline for the first time. The plan was part of a \$2.8 billion national program jointly funded by ADB, the Vietnamese government and other developmental partners.

Waste Water Systems & Infrastructure



Lotte E&C, Huvis Water and Honor Shine Global JV (Korea) in 2017 proposed a US\$490 million wastewater treatment system in Ho Chi Minh City, to be constructed under a build-lease-transfer (BLT) model over 35 hectares in Binh Tan district with total capacity of 650,000m³/day.

Royal Haskoning DHV (Netherlands) in 2017 signed a \$11.07 million contract with the Ba Ria Vung Tau Urban Sewerage and Development Company (BUSADCO) to implement a WWTP and piping system for Phu My New Urban Area in southern Ba Ria Vung Tau province with total capacity of 30,000m³/day.

Vietnam-Oman Investment Company has invested US\$225 million in phase 1 of Duong River Surface Water Treatment Plant in Hanoi, covering 62 hectares and with a 76km-long pipeline. Capacity of 150,000m³/day is anticipated by 2018 and 300,000m³/day by 2020.

ODA from the Japan International Cooperation Agency (JICA) invested in the US\$ 800 Yen Xa wastewater treatment facility in Hanoi which started construction in October 2016. The plant has a design capacity of 270,000 m³/day with a 52km-long pipeline, to start operation in 2019. JICA has also funded Da Nang's pre-feasibility studies for the Hoa Lien Water supply plant and Khanh Son waste treatment plant, and is supporting private companies in the city to improve the skills and management of PPP projects.

German government's ODA invested US\$18.4 million, and **Switzerland government** invested US\$1.8 million in a WWTP and drainage system in the northern city of Hoa Binh, in construction since late 2015. The project involves construction of a master sewer, 16 wells to separate rain water and sewage, 1,004 catch pits, 4 pump stations and a sewage treatment plant using biological treatment technology with a capacity of 5,120m³/day.



Flood Control Infrastructure

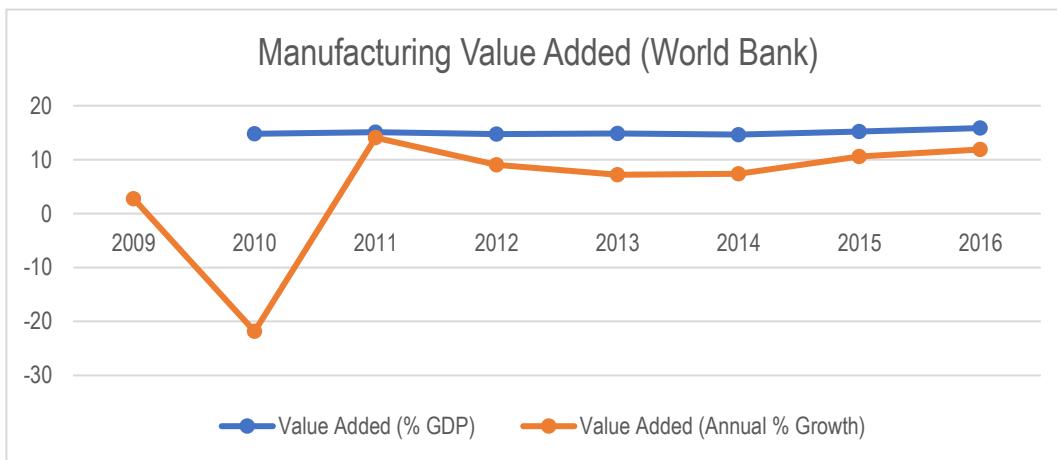
Rotterdam city (The Netherlands) and HCMC have partnered to develop ‘Ho Chi Minh City, moving towards the sea with climate change adaptation’ program, within the Vietnam Climate Adaptation Partnership (VCAP) to keep the delta area economically prosperous and protected. The Netherlands leads global innovations in infrastructure to build city resilience to rising sea levels, particularly in its major port city Rotterdam.

JICA ODA has invested in a PPP to redevelop Vietnamese rivers as part of flood resilience. The US\$212 million project to be completed by 2020 aims to redevelop flood-prone areas along a branch of the Saigon River about 10km away from Ho Chi Minh City.

ADB will loan US\$400 million and the **Urban Resilience Fund (URF)** will loan \$5 million to a wastewater and drainage improvement project to adopt climate change resilience strategies in Ho Chi Minh City.

Opportunity for Investment: WWTPs for Industrial and Manufacturing Sectors

- Foreign ‘blue chip’ companies (corporations with a national reputation for quality, reliability, and the ability to operate profitably regardless of economy) with industrial factories in Vietnam offer greater potential for return on investment. Their strict regulatory environment means waste water treatment services must be installed and of high standard. These private companies should have a high-growth trajectory to maximise economies of scale for installed water-related services.
- As China is becoming too expensive for industries, the manufacturing industry is shifting to Vietnam where land is affordable and labour is young, competitive and cheap. Vietnam is now moving into low-cost manufacturing for export. As half of the population is under 30 years old the labour force is expected to continually expand in the next 20 years (Business Monitor International, 2017). In 2016 the manufacturing industry grew favourably at 11.9% (World Bank) supported by diversity in terms of geography and product and a wide-range of Free Trade Agreements.



- Vietnam is quickly being invested in for electronics manufacturing which demands a reliable and pure water supply. For example, a semi-conductor manufacturing plant may use 7,500 – 15,000m³ ultra-pure water every day. Meanwhile, *Semiconductor Equipment and Materials International* expect the semiconductor industry in Vietnam to grow at a compound annual growth rate (CAGR) of 14.3% over the period of 2014 to 2019.
- Membrane technology for wastewater treatment is also expanding in Southeast (SE) Asia for its high quality and efficiency, comprising Microfiltration (MF), Ultrafiltration (UF), Nanofiltration (NF), and Reverse Osmosis (RO). The market’s forecasted Compound Annual Growth Rate (CAGR) is 10.9% from 2016 to 2021.