



EMBASSY OF DENMARK
Accra

Intended for

Danish Embassy, Trade Council,
Accra, Ghana

Date

December 1, 2020

GHANA WASTEWATER MARKET SURVEY



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Project name: Wastewater Market Survey, Accra, Ghana

Project no.:

Recipient: Danish Embassy, TC, Accra, Ghana

Document type: Report

Version: 01

Date: November 30, 2020

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Description: Wastewater Market Survey, introduction of
Danish technology to Ghana

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1. BUSINESS OPPORTUNITIES FOR DANISH WATER TREATMENT COMPANIES IN GHANA, SUMMARY

This report is the outcome of a market survey commissioned by the Royal Danish Embassy, Accra-Ghana. The objective of the survey is to provide an overview of Ghana's wastewater sector, stakeholder and market conditions, and more importantly, identify challenges in the sector, which could be opportunities for business collaboration between Danish water technology companies and local solution providers.

Business potential with Ghanaian companies and organizations

- International and multinational companies
- Export companies
- Companies with high resource costs (water reuse and power from sludge)
- Wastewater treatment utilities

The survey team actively engaged a number of relevant public and private businesses, as well as local authorities and agencies to map business potential for application of Danish water technology in Ghana.

In the end, the survey identified international and multinational companies/businesses, which provide the highest business potential for Danish technology with the available budget, environmental and corporate responsibility, and brand protection being major considerations.

Technology demand

- Water treatment for reuse
- Polishing of secondary effluent to drinking water standards
- Power production from sludge gas
- Household treatment systems
- Full and partial industrial systems
- Pretreatment
- Operation and maintenance skills and technologies
- Salinity reduction
- Flocculation

Furthermore, indigenous Ghana businesses exporting to EU and other western markets are potential targets for Danish solutions as they are required to comply with the effluent standards of these markets.

Industries in Ghana require different treatment technologies, from full treatment solutions to separate sub processes for polishing of secondary effluent and sustainable use/reuse of water. For example, treatment plants require solutions for gas harvesting and energy production, where as treatment of wastewater from Ghana's budding oil



Photo of sewage/storm water Nima Drain in Accra.

salinity. In addition, pretreatment inefficiencies are also a challenge for many of the wastewater treatment facilities. These all present opportunity for the implementation of Danish technologies in wastewater treatment. There are a number of relevant industries in Ghana. For this survey, the primary focus was on food and beverage, mining, oil and gas, pharmaceutical and life sciences, textile, wastewater utilities and consumer goods. In all these industries, there were identifiable opportunities for Danish Technology requirements. Furthermore, it is the opinion of the project team that there are more opportunities within some of the other industries not investigated here.



To support the entry of Danish technology into Ghana, the Trade Council at the Danish Embassy in Accra is ready to assist Danish companies with relevant technologies and solutions. With a permanent physical presence in the country, the Trade Council can set up and facilitate dialogue

between Ghanaian companies and the respective Danish technology providers. The Trade Council will provide effective on-the-ground-support to the Danish technology providers.

Incentives for GH companies

- Enforcement of EPA regulations (in practice mainly applied for international companies)
- Compliance with EU and US standards for exporting companies
- Cost savings

In addition, there is a support toolbox, which the Danish companies can apply for and benefit from where relevant. These include the Export Credit Agency (EKF) export financing support and the Danish investment fund for developing countries (IFU).

Sectors with business potential

- Food & beverage
- Pharmaceuticals
- Mining
- Wastewater treatment utilities
- Textiles
- Consumer goods

The Trade Council continuously monitors public and private initiatives within the wastewater sector in Ghana and are on hand to provide useful information to assist Danish companies to tap into new market openings. With “boots on the ground”, the Trade Council can carry out the daily engagements with stakeholders and potential customers. The Trade Council also follows and promotes initiatives from the Danish Government in order to maintain and keep the support toolbox for Danish companies updated.

Support tools for DK companies

- Export Credit Agency (EKF) - low interest loans for the Ghanaian companies and payment guarantee for Danish companies.
- EKF Green Accelerator grants
- Danish Investment Funds for Developing Countries (IFU)
- Assistance from the Trade Council (TC) at the Danish Embassy
- Strategic Sector Cooperation between Tema, Accra and Aarhus Municipality.



Photo of a coastal area (Elmina), east of Accra, Ghana.

2. BACKGROUND

2.1 Ghana beyond aid

Ghana has, in recent decades, experienced steady economic growth earning the categorization as a lower-middle income country in 2011. The relative security, political stability and acceptance of democracy as a tool for economic development has built both local and foreign investor confidence creating massive public and private investments in power and energy, transportation, telecommunication, hospitality and manufacturing.



In line with these developments, the Government of Ghana in 2017 developed a strategy called “Ghana Beyond Aid” with an objective to spur economic growth and build a culture of self-reliance in Ghana. The strategy is supported by several specific policies to industrialize the Ghanaian economy and reduce poverty.

In recent years, the Embassy of Denmark in Ghana has mirrored this strategy by gradually transitioning from traditional aid to a focus on trade, commercial collaboration and other new types of partnerships. One such area is the water sector, where Denmark is considered a pacesetter with several technologies and solutions applicable in Ghana.

The Embassy is today building on a solid foundation from many years of development cooperation in the water sector. Danida's support of more than DKK1 billion from 1993 to 2008 to Ghana's water and sanitation sector has been instrumental in the country meeting the Millennium Development Goals on water.

More recently in 2015, Danida Sustainable Infrastructure Fund (formerly Danida Business Finance) supported the Accra Metropolitan Assembly under a build - operate - transfer

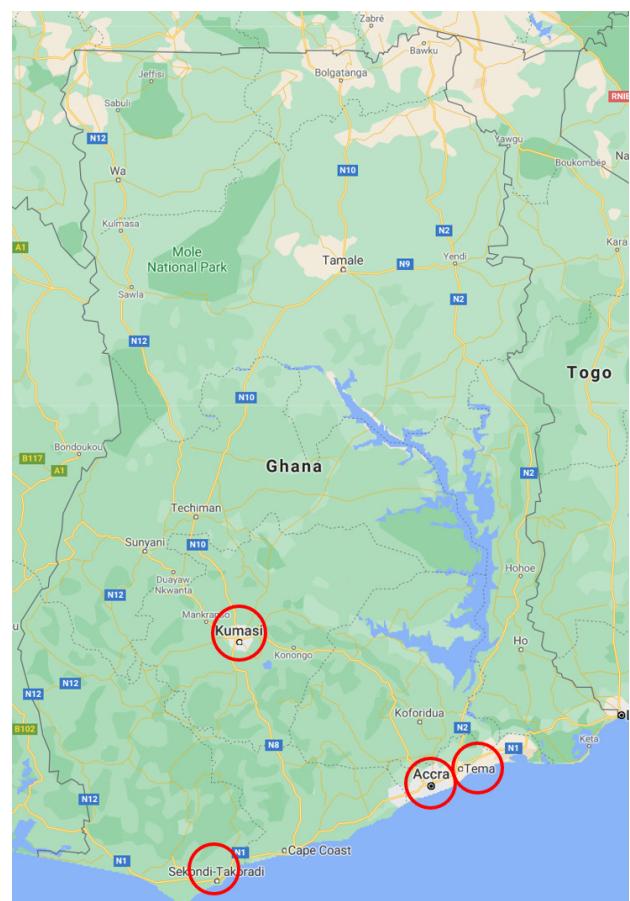
arrangement with a private company to build an 800 m³ capacity low-cost solution for faecal sludge treatment through dehydration of faecal sludge.

Through decades of development cooperation, the Embassy has built strong networks and knowledge of the local water sector, which can now benefit Danish companies with an interest in the market.

Among the new types of partnerships, the Embassy facilitates a Strategic Sector Cooperation on Urban Water between Aarhus and Tema Municipalities with a focus on wastewater management and climate adaptation as well as non-revenue water.

2.2 Wastewater in Ghana

Sanitation and waste management in Ghana remains a major challenge especially in the highly populated cities of Accra, Tema, Kumasi and Sekondi-Takoradi.



Map of Ghana (Google maps) showing location of the highly populated cities of Accra, Tema, Kumasi and Sekondi-Takoradi.

Several decades of uncontrolled and improper handling, treatment and disposal of both solid waste and liquid effluent from industrialization and unbridled urbanization has resulted in severe environmental degradation of both inland and coastal waters. Major sources of potable water production as the Oda and Owabi Rivers in the Ashanti Region and the Pra River in the Western Region have become highly polluted with industrial and domestic waste, leading to increased cost of production by the national utility company, the Ghana Water Company (GWCL). The story in Accra and Tema is no different as key lagoons including the Korle, Kpeshie, Klottey, Sakumono and Chemu, were once vibrant and served as sources of livelihood for the citizens, and have over the years been reduced to receptacles of untreated industrial and domestic wastewater.

Challenges

- Untreated wastewater from industry and households
- Environmental issues
- Polluted water resource



Photo of the polluted Korle lagoon next to a sewage treatment plant.

Industrial Wastewater

Ghana's main industries are within food and beverage, mining, cement, and oil and gas. During the last decade, operations in power and energy, chemicals and life sciences have seen major expansion. More than 70% of these industries are concentrated in the Greater Accra, Ashanti and Western Regions of the country with the remaining sparsely located across the other regions.

The operations of these industries either require large volumes of water as a main part of production element or as utility for efficient operation of these factories. An estimated 30% of this water ends as effluent/wastewater with various physical, chemical and biological pollutants. According to regulations on wastewater management by the Environmental

Protection Agency in Ghana, this wastewater either requires treatment to acceptable levels before being discharged into the environment or re-used for other purposes, e.g. cooling water, cleaning of trucks or roads. Unfortunately, the reality is that wastewater treatment remains one of the most undeveloped aspects of manufacturing/production in all industries across the country. Most effluents from production are either not treated at all, or at best, not treated up to required environmental standards before discharge into the environment.

Municipal Wastewater treatment

Ghana has very low sewage coverage for wastewater management and treatment compared to other countries with the same level of economic development. The national average for sewerage coverage is estimated to be below 5%, with management and supervision mostly under the purview of the various local government authorities.

Homes, in general, rely on septic systems, where the effluent is collected by trucks and transported to designated sewage treatment facilities for treatment. There are also a few central sewage treatment facilities covering portions of the larger cities of Accra, Tema and Kumasi that date back to the 1950's and 1960's

- Low sewerage coverage
- Non-functional treatment plants

The wastewater situation in Ghana presents various business opportunities for Danish technology providers. Based upon the previously described positive economic and political developments, Danish companies with relevant technology and solutions are encouraged to explore the Ghanaian market, with the available "on the ground" support of the Trade Council of the Danish Embassy in Accra.

3. PURPOSE

The overall purpose of this survey is to provide Danish wastewater technology companies with information that can facilitate their introduction into the Ghanaian wastewater market. The survey seeks to provide an overview of both the public and the private wastewater sector, including motivations for local industries and governments to establish wastewater treatment systems on market terms.

The survey investigates and assesses if and why Ghanaian public organizations and private companies have a motivation for acquiring and implementing Danish wastewater technologies. The survey includes assessments of:

- Wastewater treatment requirements by Ghanaian companies and institutions.
- Organizational set-up of the various regulatory agencies.
- Business opportunities: short term vs long term, market-based vs donor funded.
- Motivation and incentives.

Relevant Danish technologies will be presented and matched with Ghanaian demands.

The survey describes the Ghanaian market in a form that presents relevant baseline information for Danish companies considering an entry into the Ghanaian market.



Photo: Visit at one of the largest textile manufacturers in Ghana. Open sewage drain from production can be seen on the photo to the left.



4. METHODOLOGY

This section describes the overall methodology applied in order to assess the wastewater market in Ghana.



Photo of Ramboll international consultants at a wastewater treatment installation for the oil & gas industry in Sekondi-Takoradi. Facility has the capacity to treat about 250 cubic meters of oil wastewater per day.

Government and public organizations

Ministries, regulatory agencies and local government/metropolitan/municipal authorities were interviewed about:

- Policies and strategies
- Institutions and responsibilities
- Regulation
- Enforcement
- Existing wastewater management efficiency
- Technical issues
- Investment plans/needs
- Challenges and barriers
- Incentives
- Skills and training

Private Industry

Private companies in Ghana were visited and for most companies the visit included an interview and a tour of the operational and process facilities, including an onsite presentation of existing wastewater treatment systems. Output from the visit included information on:

- Business strategy and future wastewater treatment demands
- Current wastewater management
- Technical treatment issues
- Investment plans/needs
- Challenges and barriers
- Incentives
- Willingness to invest in Danish technology on the given terms
- Technical solutions in demand



Photo of Trade Council expert and Ramboll international and local consultants at a wastewater treatment plant at a gold mining company in the Western region of Ghana. There are over 16 of such mining companies across the country.

- Business models
- Export requirements related to export to EU and US
- Skills and training

Stability and Ease of Doing Business in Ghana

The assessment of economic and political stability, ease of doing business and potential risks are based on insights and knowledge from the Danish Embassy and selected stakeholder interviews.

Export supporting tools

Danish tools that can support successful export based on market terms are mapped. These include payment guaranties, low interest loans, and investments.

Trade council support

The specific challenges in the market and pain points for Danish and Ghanaian companies will be assessed to determine how the Trade Council of the Danish Embassy in Ghana can support the introduction of Danish companies and how they can assist in a long-term engagement.

Match with Danish companies

The main objective is to find the matching Danish technology and provide an expression of interest from the Danish companies. The dialogue with the Danish companies will be based on findings from the Ghanaian companies and “external tools” to support the market approach.



Photos of a sedimentation lagoon at a mining site in Ghana. Ramboll consultants visiting the lagoon.

5. OVERVIEW, BUSINESS OPPORTUNITIES IN PRIVATE SECTOR/ INDUSTRIAL WASTEWATER MANAGEMENT

The industrial sectors in this survey represent the main industries in Ghana and include food and beverage, consumer goods, oil and gas, mining and chemical and life science industries.

- Good business potential with
 - international companies,
 - multinational companies and
 - local exporting companies
- Incentives for wastewater treatment are
 - enforcement
 - export - foreign standards
 - savings
 - CSR

6.1 Business potential

A potential for selling Danish wastewater technology is mainly found among the following company types:

- International companies that must comply with regulations for different reasons (enforcement, CSR etc.) and therefore require efficient wastewater treatment technologies.
- Local export companies which require efficient technologies, as they must comply with regulation to meet standards in the importing countries (EU and US).
- Local and international companies, where efficient wastewater treatment can optimize resources and reduce costs (water reuse, energy production).

Other local companies are considered to have less business potential as it will require further enforcement to ensure that they will invest in improved or new wastewater management.

6.1.1 Incentives

This paragraph describes the incentives (or lack of) for the companies to apply wastewater treatment systems.

6.1.1.1 Enforcement - International Companies

In general, incentives relating to the regulatory enforcement by the authorities are limited. The EPA has, as mentioned previously, limited resources and for the most part focus their attention on large international companies. On the other hand, local Ghanaian companies, for a large part, emit untreated wastewater into the environment or into a dysfunctional sewer system.

6.1.1.2 Complying with international effluent requirements - Export Companies

Local companies aiming to expand their market to the EU and US, and local companies already on these markets, must comply with EU and US standards. These companies have a need for documented long term efficient and sustainable wastewater treatment systems that comply with EU and US emission standards and are therefore motivated to implement efficient wastewater treatment.

6.1.1.3 Resource Efficiency/Savings

Local food and beverage companies with a high use of water in the production have expressed an incentive related to cost savings. This is by implementing water reuse systems that pricewise are competitive with water supply costs. Water reuse includes reuse of slightly polluted water for toilets and floor washing as well as treatment solutions that can clean and reclaim wastewater up to a high quality.

6.1.1.4 Corporate Social Responsibility (CSR)

CSR is a motivation to comply with wastewater regulation, especially for international companies but also for some local companies. It is important for companies to demonstrate that the business takes an interest in wider social issues, rather than just those that impact profit margins. This attracts customers, who share the same values, as well as improve authority relations.

6.1.2 Barriers and Challenges for Businesses

Large international and multinational companies often have the necessary incentives to invest in efficient wastewater treatment technologies. These companies will be promising purchasers of Danish wastewater technologies. However, large multinational companies often have agreements with technology providers through their head offices. They aim at consistent and uniform production facilities and often engage the same company to solve a given problem in all branches. It can be difficult to get an agreement with the local branch. However, none of the interviewed international companies mentioned that this would be an issue.

There are barriers related to improving and maintaining existing equipment. Some of the interviewed companies had established treatments

systems delivered by foreign providers; however certain technical and operational challenges have resulted in shortfalls in meeting effluent standards. The technical issues could be solved by Danish knowledge and technology, but the local companies would then not be able to maintain the guarantee provided by the company that originally set up the treatment system. The companies can potentially be locked to a certain supplier in order to maintain the guarantee.



Photo: Visit to fruits cut processing facility for export on the outskirts of Accra.

A general issue mentioned at several companies when using foreign wastewater treatment equipment is delivery of spare parts during a case of a system breakdown. A delivery time from, for example Europe, is long and causes the treatment system to be out of operation/nonfunctioning for longer time periods.

6.2 Technical requirements with business potential for Danish companies

Technical demands at the interviewed companies

often relates to:

- Improving efficiency of existing equipment, including energy savings
- Design of full treatment systems producing reclaimed wastewater to EPA standards.
- Design of specific treatment steps, pretreatment, flocculation, aeration, filtering etc.
- Operation, control and maintenance - digital real time systems
- Gas harvesting and power production
- Polishing of reclaimed water (rootzone treatment, artificial wetlands, managed aquifer recharge)

6.3 Stability

The stability of the selected companies is regarded as high. Most have a long history and growth rates mirroring the rest of the economy.

6.4 Skills and Training

In general skills related to operation and maintenance are good. However, introduction of new technologies must be followed up by training - preferably reoccurring, as well-trained staff tends to leave the companies.

6.5 Anti-Corruption

Ghana ranked 80th out of 180 countries in Transparency International's Corruption Perception Index (CPI) of 2019 (not one of their best performances over the last twenty years). Corruption is perceived as linked to the public sector more than the private sector. It is well-known within Ghana's business sector that corruption and corruption-related activities are not accepted by Northern European companies. Consumers of Danish and other Northern European products and services appreciate these products and services for their good quality and value-for-money assurance. It is the assessment by the embassy that corruption issues can be avoided if the Ghanaian companies and end-users are engaged and dealt with transparently, as Danish companies and institutions have been known for. It is advisable, for prospective Danish technology providers in Ghana to contact the Trade Council at the Danish Embassy in Accra for further guidance.

*Photo of production and storage facilities
at a large cocoa processing factory in Tema.*





6. OVERVIEW, BUSINESS OPPORTUNITIES IN PUBLIC WASTEWATER MANAGEMENT IN GHANA

5.1 Responsibilities in the wastewater sector

Below are listed the overall responsibilities of the different government bodies and authorities.

- Ministry of Sanitation & Water Resources:
The role of this ministry, among others, is to ensure sustainable and effective management of liquid and solid waste to reduce environmental pollution. This includes the formulation of general policy framework and investments in municipal liquid and solid waste management. The ministry is currently the government agency with the responsibility of supervising and paying for the operations of the single largest private operator in Ghana's municipal waste management sector, Zoomlion.

- Ministry of Trade and Industry:
The Ministry of Trade and Industry has the mandate, working with the private sector, to activate industrial parks and special economic zones within all the 16 regions of Ghana. The ministry is also responsible for general policy framework for these industrial parks.

- No funding for public wastewater management
- Only few sewer systems in operation
- Wastewater management based on decentral septic tanks
- Lacking treatment capacity
- Limited enforcement by authorities

- Municipal Assemblies:
Local government authorities are responsible for the operation and management of waste management systems across the country. Over the last couple of years many municipalities and district assemblies have been partnering with private investors for waste management solutions on a build-operate-transfer (BOT) basis. Zoomlion is one such private operator working with a number of municipalities in this area.

- Environmental Protection Agency:
The EPA is an independent public body mandated by law to regulate the environment and ensure the implementation of government policy on the environment. The responsibility for environmental protection and improvement includes regulatory and enforcement roles, including public and private wastewater emissions.

- Utilities:

Wastewater treatment - The Jospong Group (Zoomlion) is by far the biggest operator in the municipal liquid and solid waste treatment in Ghana. With subsidiaries such as Sewerage Treatment Ghana Limited and Zoompak, Zoomlion operates across the 16 regions of Ghana and in almost all municipalities and districts.

- Private Sector wastewater collection:

Private collection trucks, service paid by septic tank owners. Main operators for collection trucks are privately owned companies.



Photo from a 2000 metric tons/day treatment plant treating wastewater from septic tanks in Accra.

5.2 Challenges

One of the biggest wastewater management challenges in Ghana is found in Tema, an industrial city built in the 1960's. Originally developed with a well-functioning sewer system, today it is degraded due to lack of maintenance, resulting in 80,000m³ wastewater per day bypassing drains and emitting untreated into the ocean. The municipal assembly lacks human capacity to maintain and develop the sewer system. Furthermore, normal funding mechanisms are out of operation as the municipal assembly cannot charge for wastewater emissions in a system that does not work. Therefore, funding for maintenance and development is lacking.

In order to improve the maintenance system, the

government has decided to establish a new National Sanitation Authority, with its own funding. Implementation of this authority is currently at the planning phase.

Apart from the now broken Tema central sewage system, another system for the central business district of Accra and some institutions in Accra and Kumasi with small treatment systems, the rest of Ghana's sewage treatments solution is based on a house to house collection model, whereby septic trucks transport wastewater from various homes and institutions to treatment facilities at a fee. This model is fraught with many problems, including accessibility to certain locations and long distances from treatment facilities.

Ghana's Environmental Protection Agency faces challenges in their efforts to enforce regulation due to limited resources, staff strength, logistics and other challenges.

5.3 Municipal wastewater management business potential

Short-term business opportunities for Danish wastewater technology companies in the public sector are assessed to be limited.

Long-term opportunities can develop over the coming years. There is a huge urgent need for decentral solutions at medium scale towns. According to the Ministry of Sanitation and Water Resources, plans are in place to develop decentralized wastewater management systems in urban areas and a revamp of existing systems. Improvement of the municipal wastewater management systems will rely on external funding from development banks and similar institutions. A feasibility study, with financial support from the African Development Bank, looking to establish wastewater treatment plants in twelve municipalities, is underway. Also, a feasibility study funded by the World Bank for the refurbishment of the Tema Central Sewage System is in the tendering process. The feasibility studies will map the technical, financial and organizational needs and provide help to the local government to apply for external funding. The development of large urban wastewater management projects must be followed in dialogue with the government and the development banks in order to spot upcoming business opportunities for Danish companies.

- Limited short-term business potential in public wastewater management
- Large need for technical solutions
- Long term business potential depending on future public funding and training

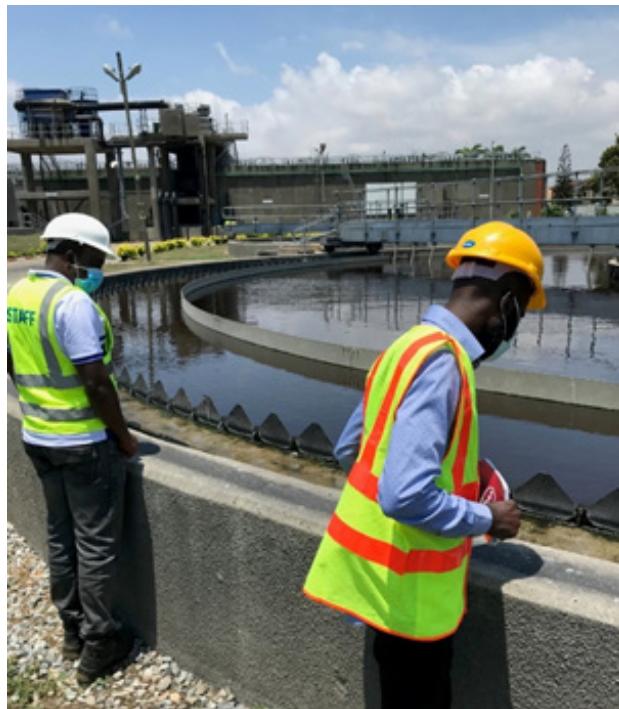


Photo of Ramboll international and local consultants visiting the largest municipal wastewater treatment plant in Accra.

5.4 Technical requirements

This section describes requirements for the public sector and is based on shortcomings in the wastewater management system including infrastructure and wastewater treatment technologies. The requirements for the public wastewater sector are many and include:

- New sewer systems
- Decentralized treatment plants
- More capacity at the municipal treatment plants/new plants
- More enforcement to secure treatment at the local factories before emission to the recipient, treatment plant or the waterways.
- Improved operation and maintenance of the full wastewater management value chain including:
 - Real time process monitoring
 - Pretreatment – solid removal
 - Flocculation
 - Aeration
 - Operation and maintenance training
- Improved wastewater collection
- Biogas harvesting and energy production

5.4.1 Economic stability

Ghana's industrial sector, with an average annual growth exceeding 10%, has been a major driver of growth in Ghana (African Development Bank).

The industry has benefited from trade liberalization, political and economic stability, regulation and a more streamlined environment for private investment. The development of the industry is supported by several governmental plans and initiatives.

Data from the Global Water Intelligence (GWI) estimate a compound annual growth rate (CAGR) of 14 % in the total wastewater investments in Ghana over the next 5 years.

The largest investments are estimated by GWI to be within sewage systems, whereas the wastewater treatment plants only include around 20% of the total wastewater CAPEX investments. Overall, the data from GWI indicate that there is a stable situation and a considerable growth.



Photo: Ramboll consultants discussing treatment efficiency with local wastewater plant operators at a textile industry in Eastern Region of Ghana near the Volta River.

5.4.2 Skills and training

Skills for efficient operation and maintenance of existing systems within the responsible municipalities are lacking. With considerable lapses in monitoring and enforcement by the EPA, there is little to no investment in building the capacity and skills of wastewater management engineers and technicians as opposed to other areas of production.

There are currently no plans from government for training and education in areas relevant for wastewater management and wastewater regulation enforcement. This is an issue, as Danish technology can only be introduced successfully if the potential end-users have the necessary knowledge to understand how it will benefit wastewater management in Ghana.



7. OVERVIEW, BUSINESS OPPORTUNITIES IN WASTEWATER TREATMENT UTILITIES

7.1 Wastewater Business Description

Within the Greater Accra region, most of the wastewater treatment is managed by one privately-owned company, Zoomlion (Jospong Group), which also operates waste management facilities in other parts of the country. The company runs three treatment plants in Accra. The total capacity of the three plants is 2,000m³/day. There is a demand for treatment of at least 20,000m³/day. The treatment company plans to enlarge the capacity accordingly by establishing new treatment plants.

As a business model, the cost of processing, treatment and disposal of sewage by Zoomlion is publicly funded through the Ministry of Sanitation and Water Resources, while company and other privately-owned collection trucks charge a fee from individual home owners and institutions for collection and transportation of sewage to the treatment plants.

A smaller waste and wastewater treatment company with a business model, based on the oil and gas industry in the Western region of Ghana, was also interviewed and visited. They try to compete with the large company in Accra - especially on the septic tank collection business.

7.2 Business potential

Business potential for wastewater treatment utilities are solutions that can increase earnings, water reuse and power production from harvested gas

7.2.1 Incentives

Two treatment plants were visited – one treating wastewater collected from septic tanks and one connected to the sewer system of central Accra.

From our discussions and subsequent tour of the site, there is room available for engineering and process improvement to better achieve the effluent requirements as expected.

The primary incentive and driver for the company and the two treatment plants would be to increase earnings.

7.2.2 Barriers and challenges

The existing treatment plants have all been financed with foreign development funds and foreign companies respectively.

The two sites that were visited were of British and Chinese technology, with British and Chinese



Photo: Sewage treatment at a municipal wastewater treatment plant in Accra.

concessionary loans. For the planned new treatment plant(s), the company will probably again implement solutions that are close to fully funded by development funds. As Denmark no longer provides traditional development aid to Ghana, other sources of funding such as Danida Sustainable Infrastructure Finance (DSIF) will need to be explored.

For the existing plants, despite the procurement being tied to the discretion and approval by the original project financiers, they are open to procuring technology from other countries.



Photo: sludge handling at a municipal wastewater treatment plant in Accra.

7.3 Technical requirements with business potential for Danish companies

The treatment plants visited both have gas production from the sludge. The gas is flared and neither harvested nor used for energy production. Applying a system for energy production is assessed to have a good business potential. It will improve earnings and thereby support the company's main incentive.

Other technical demands with less business potential include problems with pretreatment. The content of solid waste and sand in the received wastewater is high and causes clogging of the system.

In the British plant, which is connected to the sewer system, they have problems with oil content and need a method to scoop the sand for oil more efficiently.

The Chinese plant is controlled manually, and in general not operated efficiently. It would be relevant to apply real time monitoring and process control systems. Further serious corrosion issues were obvious on the Chinese plant despite being newer than the British plant.

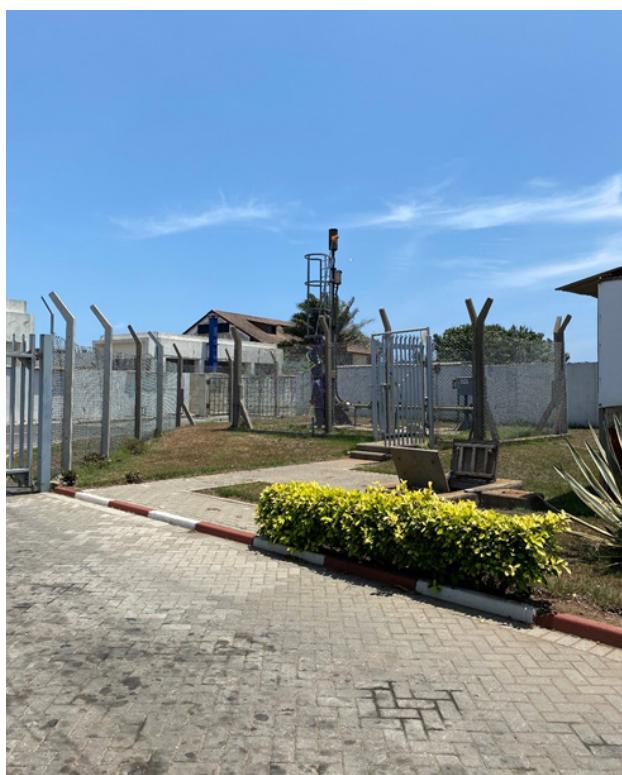


Photo of the flaring system at a municipal wastewater treatment plant.

7.4 Stability

The operator has a large market share and will probably maintain it in the near future. The company plans to increase their market in other parts of Ghana and could become a future important customer for Danish companies.

7.5 Skills and training

The skill level for the operators of the facilities is not high. This should be considered when suggesting different technologies.



Photo of large valves (not AVK) at a municipal wastewater treatment plant.

8. OTHER INDUSTRIES

8.1 Industrial parks

The development of industrial parks is a focus area for the Ghanaian government. Through the Ministry of Trade and Industry, the government is working with private investors to create industrial parks and special economic zones in all 16 regions of the country. Focus is on industries within aluminum processing, pharmaceuticals, agricultural processing, textiles and apparel. Plans also include the establishment of a technology park.

Industrial parks are private sector led, where government will provide relevant and necessary support to private investors to set up these parks. There are two types of parks: specialized and multipurpose.

Industrial parks wastewater emission systems must be approved by the EPA working with the Ministry of Trade and Industry. Enforcement lies with the EPA and the municipal assemblies are responsible for the sewer systems and treatment outside the industrial parks.

As part of the survey, the Ghana Free Zones industrial park and the Tema Port Enclave, both located in Tema, were visited. The parks did not have a treatment facility on site. The treatment responsibilities are with the companies, who are required to treat their wastewater to within EPA standards before emission into the municipal sewer system. The business potential lies with the companies in the parks.

To interact with potential customers in due time, government programs for building industrial parks should be followed.

8.2 Hospitals

The Government of Ghana is investing heavily in hospital infrastructure all over the country. In response to the COVID-19 pandemic, the government has launched an initiative to build 111 hospitals across the country within the next two years.

It is difficult to assess the business potential for now, but the Trade Council continues to monitor developments and can facilitate access to the relevant contacts in order for Danish companies to get an opportunity to take part in the tendering process.



Photo of an industrial park in Ghana.



9. DANISH EXPORT SUPPORTING TOOLS

The introduction of Danish technologies in Ghana on market terms is competing with other countries technology providers that enter the market with the “full national support package” i.e. with full project funding.

In order to enhance the chances for a successful introduction of Danish technology, it is necessary to support the market venture with all available support opportunities.

9.1 Financial support tools

9.1.1 The Danish Export Credit Agency (EKF)

EKF can support the market-based introduction of Danish technologies by providing long-term bank financing and guarantees, investment guarantees as well as other financial credit facilities that:

- Help the Ghanaian company finance the purchase of Danish goods by, for example, making it possible for the Ghanaian company to obtain local bank loans at very favorable interest rates, thereby reduce overall costs, especially with respect to the high initial costs associated with implementation of high-quality equipment.
- Ensure the payment for Danish companies selling services and goods to Ghana. With EKF guarantees, the Danish companies does not have to fear losses, in the event that Ghanaian companies for some reason cannot pay for the delivered equipment.

EKF can either provide single guarantees or a group of companies can choose to set up an EKF shopping line where Ghanaian companies, if they buy Danish equipment, get low interest loans and the Danish companies will have a money back guarantee as described above. EKF also has a new “Green Accelerator”, which provides grants for export of green solutions and green alternatives that face specific market barriers.

9.1.2 The Danish Investment Fund for Developing Countries (IFU) DSIF

IFU can via its different investment funds support projects in Ghana improving sustainable development. IFU could be relevant both for companies, wastewater treatment utilities and other businesses with a business model where the Return of Investment is convincing. Funds under IFU include:

- Danida Sustainable Infrastructure Finance (DSIF)
- Danish SDG Investment Fund

9.1.2.1 Danida Sustainable Infrastructure Finance (DSIF)

Danida Sustainable Infrastructure Finance (DSIF) can provide access to finance and can leverage finance for sustainable infrastructure projects in developing countries. DSIF is managed by IFU on behalf of the Danish Ministry of Foreign Affairs. A typical loan has 10 years' maturity and is issued in USD or EUR. The DSIF subsidy covers:

- Interest in the whole duration of the loan
- Export Credit premium and other financial costs
- Cash grant to reduce the principal of the loan (in case interest, premium and financial costs do not constitute 35% or 50% subsidy level, a cash grant is included in the subsidy to reach the minimum levels required by the OECD)

There are two approaches under DSIF:

- DSIF Classic: Tender limited to Danish companies where DSIF financial support has been approved prior to tender
- DSIF Fast Track: International tender where DSIF can provide financial support in case a Danish company is the best evaluated bidder (DSIF support approved after tender evaluation).

9.1.2.2 The Danish SDG Investment Fund

The Danish SDG Investment Fund is a public-private partnership, which will contribute to fulfilling the 17 UN Sustainable Development Goals (SDG) through private sector investments.

The fund offers advice and risk capital for projects supporting the development in strategic sectors in developing countries. This includes climate, agribusiness and food, the financial sector, water as well as production and infrastructure.

9.2 Training and demonstration in Denmark

During the many interviews, training has been highlighted as an important demand among both public and private sector wastewater managements. Many Danish water companies conduct training

and demonstration, which is highly valued by the Ghanaian public and private counterparts.

The Danish Embassy furthermore supports full scholarship university courses managed by the Danida Fellowship Centre (DFC) in Denmark. The DFC courses are linked to a public Strategic Sector Cooperation Program between Denmark and Ghana on Urban Water (SSC-program). Training can be considered for public stakeholders if relevant for the SSC-program. Private sector stakeholders will rarely be considered for DFC courses and only if directly involved in the SSC-program.

9.3 Strong Water Focus at the Embassy of Denmark

9.3.1 The Trade Council (TC)

The Trade Council can play an important role in the introduction of Danish companies as they have a permanent presence at the Embassy and over the years have gathered important information on Ghanaian market conditions including policy, regulation, development projects, economy, business opportunities etc.

Furthermore, the Trade Council has, over the years, built an important network within the Ghanaian government as well as with Ghanaian companies in various industries.

The Trade Council also has specific and detailed insights in the local wastewater market that could be important in both short and long term to support the Danish companies as their “boots on the ground”.

The Embassy of Denmark is in high regard and considered a trust-worthy partner among Ghanaian stakeholders and companies, and involving the Trade Council can help facilitate trust and credibility among Danish and Ghanaian partners.

9.3.2 Strategic Sector Cooperation on Urban Water

The Danish Ghanaian Sector Cooperation is a partnership between municipality of Aarhus (including Aarhus Vand) and the Tema Municipal Assembly, which focuses on wastewater management and climate adaptation in the Tema area and non-revenue water, with the Ghana Water Company Limited as the main partner on the latter.

A wastewater and climate adaptation plan is under development and a first draft is expected to be

discussed at the political level in the second half of 2021. Activities related to knowledge sharing with regards to Danish wastewater treatment technologies could be aligned with the SSC program activities.

10. MATCH BETWEEN GHANAIAN PRIVATE COMPANY REQUIREMENTS AND DANISH TECHNOLOGIES

The following section describes the tangible outcomes of the interviews and company visits carried out over a period of 14 days in October and November 2020.

The description only includes companies that are assessed to have a business potential for Danish technologies. The relevant Danish companies are listed next to the Ghanaian companies.

Out of the listed Danish companies, the following have confirmed interest in engaging in the Ghanaian wastewater market:

- Landia
- BWSC
- Grundfos
- Novozymes
- Norlex
- Pilerensning.dk
- Bioland/Biokube
- Krüger
- Ramboll
- WSP/Orbicon
- AVK

The Ghanaian companies are anonymized but contact details and minutes of meeting etc. can be provided by the Trade Council at the embassy in Accra.

The description mainly focuses on short term business opportunities.

Company A - Textile production

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National	Water savings with reuse	Enhanced flocculation in existing equipment to improve overall efficiency. Long term: new full system.	Good if flocculation technology is efficient	Novozymes and Norlex

Company B - Pharmaceuticals

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National	Water savings from water reuse, on longer term - compliance with EU and US standards on new production facilities	Water reuse, polishing methods to bring reclaimed water to a high quality. Reverse osmosis (?) and more sustainable solutions including MAR	Good	Companies that deliver solutions to Novo Nordisk and Lundbeck, Novozymes, Krüger, consulting engineers

Company C - Waste Utility for oil exploration

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National	Business model is to win customers with efficient waste treatment and reuse	Wastewater from ocean drilling platform have varying saltwater content - needs to be controlled. Efficient flocculation method. Biogas production	Good - they have efficient systems in place - and thereby show they are willing to invest.	Novozymes and Norlex, RGS90, Krüger, Landia, BWSC, Assentoft Silo, consulting engineers



Photo from wastewater treatment plant in Western Region of Ghana, treating wastewater from offshore oil drilling rigs.

Company D - Gold mine

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Enforcement and CSR	Small household wastewater treatment plant for the emissions from employee compound. Pumping requirements.	Good, due to the incentives.	Bioland/Biokube, Grundfos



Photo of planned site for wastewater treatment plant at a Gold Mine in Ghana.

Company E - Wastewater Utility

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National	Savings	Energy production from gas. The gas is available with applied technology, but is flared	Good if RoI is short/convincing	Krüger, Landia, BWSC, Consulting Engineers

Company F - Beverage

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Water savings with reuse	End of pipe polishing method for reclaimed wastewater - MAR	Good if hydrogeology is suitable for MAR	Consulting Engineers

Company G - Food and beverage

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Enforcement, CSR, water savings with reuse	Flocculation and energy production from sludge	Good, already have one of the most efficient treatment systems in Accra area	Consulting Engineers

Company H - Food and beverage

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National export	Compliance with EU standards. Water savings with reuse	Rootzone treatment system and artificial wetland. Energy production from sludge.	Good – space for artificial wetland available.	Consulting Engineers, Krüger

Company I - Pretreated food

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
National - Export	Water savings with reuse	Have recently procured a new treatment system – not installed yet. After installation, technologies for water reuse will be in focus. Specific technologies not established	Fair – depending on the current technology providers success	?

Company J - Food

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	EPA enforcement	Optimization of existing treatment to meet EPA standards. Wastewater treatment solutions that optimize space. Water savings/water reuse.	Good, an assessment of the existing equipment is being carried out. It is planned to initiate equipment upgrade in 2021.	Consulting Engineers, Krüger

Company K - Beverage

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Water scarcity	MAR – using polished wastewater and harvested rainwater for infiltration and storage in aquifers.	Good, the water scarcity is a real problem – water supply is shut down 2 days a week.	Consulting Engineers

Company L - Food and beverage

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Enforcement, CSR	Expansion of wastewater treatment plant at confined space	Good, already have a treatment system but needs to improve and expand	Bioland/Biokube, Krüger, Consulting Engineers

Company M - Consumer Goods

OWNERSHIP	INCENTIVES	TECHNOLOGY DEMAND	BUSINESS POTENTIAL	RELEVANT FOR DANISH COMPANIES
International	Enforcement, CSR	Increase water storage capacity, water reuse, Rainwater harvesting, MAR	Good, already have a treatment system with future focus on water reuse	Krüger, Consulting Engineers

11. NEXT STEPS

11.1 Assistance from the Trade Council

In the coming period, the Trade Council will engage in a range of activities to assist Danish companies in tapping into the opportunities within wastewater management in Ghana.

The Trade Council works proactively to position Danish technologies and strengthen the Danish brand, and on demand handles specific tasks from Danish companies looking to enter the Ghanaian market. The Trade Council will support dialogue between the Danish and Ghanaian companies in order to promote acquisition of Danish technology. The short-term activities within the coming months will include:

- Webinars for information sharing
- Delegations
- Further interviews with Ghanaian companies
- Company matchmaking and 1-1 advisory
- Stakeholder engagement with public authorities
- Promoting Danish solutions to Ghanaian stakeholders and potential customers

On an on-going basis, the Trade Council follows the developments in the sector with the government, ministries, authorities and municipalities. Special focus will be to follow up on activities, plans and developments with:

- Development banks (especially World Bank)
- The new National Sanitation Authority
- Relevant ministries
- New industrial parks (tendering)
- Coordination of technology introduction with other cooperation programs
- Danish support tools



12. DANISH WASTEWATER TECHNOLOGY PROVIDERS

12.1 Technology Areas

Sewer canal inspection and refurbishment.

- Force
- Blue Ocean Robotics

Wastewater stream modeling and gravity-based optimization.

- Danish consultants, Ramboll, COWI, SWECO, Orbicon, NIRAS
- Envidan
- Krüger
- Artogis
- Danova
- DHI
- MJK

Energy optimization of wastewater treatment plants - Danish Bio refinery knowledge.

- Krüger
- Ramboll

Decentral smaller solutions for wastewater incl. root zone treatment systems

- Grundfos
- AVK
- Norlex Group
- Envidan
- Kamstrup
- Krüger
- Amphi Bac
- Artogis
- Biokube, A/S
- Grundfos Biobooster
- Landia
- MJK
- Mycometer
- Wavin
- Novozymes
- Ultraqua
- Unisense Environment
- Pilerens A/S
- Blue Ocean Robotics

Wastewater polishing

Relevant for Danish knowledge on rootzone

treatment and polishing in eco restored streams and wetlands or artificially established streams and wetlands and through MAR (Managed Aquifer Recharge).

- Ramboll
- COWI
- SWECO
- Orbicon
- NIRAS
- Envidan

Save energy

Relevant for Danish efficient pumps, drives, energy efficiency system control management.

- Grundfos
- Kamstrup
- Artogis
- Danova
- DHI
- Kemic
- Landia
- BWSC
- Assentoft Silo
- MJK

Improved water quality for emitted water from treatment plants - relevant for Danish existing filter and membrane technologies including:

- Krüger
- Novozymes
- Amphi Bac
- Aquaporin
- Grundfos Biobooster
- Landia, Mycometer
- Ultraqua
- Unisense Environment
- Norlex Group
- Suez Water
- Blue Ocean Robotics

Optimize management of gas production - Danish bio refinery knowledge:

- Krüger
- Ramboll

12.2 Danish companies

The following list includes relevant Danish companies operating within the wastewater sector. They are shown with most relevant companies in the top of the list. Relevance is based on size and existing engagement outside Denmark on market terms.

Kamstrup - water measurement systems

Assentoft Silo - wastewater, storage and biogas production

AVK - valves

BWSC - Energy production

Desmi - Pumps and environmental equipment

Grundfos - pumps and water treatment (Biobooster)

Krüger - wastewater treatment solutions, technologies and design

Ramboll - consultant, wastewater design

COWI - consultant, wastewater design

SWECO - consultant, wastewater design

NIRAS - consultant, wastewater design

Orbicon - consultant, wastewater design

Envidan - consultant, wastewater design and technology

DHI - hydraulic modelling

Amphi Bac - water quality measurements - real time

Aquaporin - water cleaning filter systems

Aquagreen - sludge treatment

Artogis - digital systems for process control

Biokube - small decentral wastewater treatment systems - down to single households

Danova - Flow measurements

Force - Inspection

Landia - physical technologies for wastewater treatment plants

Dansk Gasteknisk Center A/S - Biogas

MJK - level and flow controllers and analysis instrumentation for wastewater treatment plants, waterworks.

Mycometer - real time test system for bacteria in water

Wavin - supply pipe systems

Novozymes - wastewater treatment

Norlex Group - Water & Wastewater treatment

Silhorko - drinking water treatment and water works design/solutions

Ultraaqua - UV disinfection systems for drinking water and wastewater

Unisense Environment - direct measurements of N₂O in wastewater treatment systems

Socla - valves

Pilerens A/S - Rootzone wastewater treatment systems

Blue Ocean Robotics - wastewater systems inspection

Suez Water - Removal of pharmaceutical residue



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