

Current Status, Waste Management Strategies and Planning in Kuwait

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1. Basic information

1.1. General overview about Kuwait

Geography

Located in the north-east corner of the Arabian Peninsula with a size of about 18,000 km² Kuwait shares land borders with Iraq and Saudi Arabia, and maritime borders with Iraq, Saudi Arabia, and Iran.



Figure 1: Location plan of Kuwait and its neighbour states



Figure 2: Location plan – Kuwait

Climate

Summers in Kuwait are some of the hottest on earth like Mitribah in the Northwest of Kuwait with a recorded temperature of 54 °C on July 21, 2016. Kuwait experiences colder winters than other GCC countries because of its location in a northern position near Iraq and Iran.

Table 1: Climate data for Kuwait

Month	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high	°C	18	20	26	31	38	43	45	44	42	35	27	20	32
Daily mean	°C	12.7	14.8	19.3	24.7	30.4	34.2	36	35.9	32.7	27.5	20.3	14.5	25.3
Average low	°C	7	9	13	18	24	27	29	28	25	20	14	8	19
Average precipitation	mm	26	16	14	15	4	0	0	0	0	2	16	20	113
Average rainy	days	5	4	5	3	1	0	0	0	0	1	3	5	27

More data about the climate are available on <http://www.met.gov.kw/>. with special information about the dust situation. Dramatically sandstorms occur mainly during June and July due to heavy winds from the Northwest.

Population

The population structure of Kuwait is characterized by the very high proportion of foreign workers (around 2/3 of all inhabitants) Kuwait is one of the countries with the highest degree of urbanization (2004: 96 %); life expectancy in 2016 was 78 years. Official language is Arabic, commercial language is English.

Population of Kuwait according to nationality						
census	Kuwaiti		non-Kuwaiti		Total	Change
year	Number	%	Number	%	Number	%
1950					152,000	-
1975	305,000	31	685,000	69	990,000	551
1985	470,000	35	1,230,000	65	1,700,000	72
1995	650,000	41	920,000	59	1,570,000	-9
2005	860,000	39	1,330,000	61	2,190,000	40
2016	1,300,000	33	2,900,000	67	4,200,000	92

Table 2:

Population of Kuwait

The increase in population is from 1950 to 2016 about 4 million people. That is more than 2,500 percent in just 65 years.

Politics

Kuwait is a constitutional emirate with a semi-democratic political system. The Emir is the head of state. The hybrid political system is divided between an elected parliament and appointed government.

The Constitution of Kuwait was promulgated in 1962. Kuwait is among the Middle East's freest countries in civil liberties and political rights.

The Constitution of Kuwait was ratified in 1962 and has elements of a presidential and parliamentary system of government. The Constitution stipulates that Kuwait must have an elected legislature (the National Assembly parliament). The Emir is the head of state, whose powers are defined in the Constitution.

Government

The prime minister chooses the cabinet (government). The appointment of a new government requires the approval of the National Assembly. The Prime Minister is a member of the ruling family and is appointed by the Emir.

The Emir's powers are defined by the 1961 Constitution. These powers include appointing the prime minister, who in turn chooses the cabinet (government). Upon the death of the Emir, the crown prince succeeds. The crown prince must be approved by an absolute majority of the members of the National Assembly parliament.

On January 15, 2006 the cabinet nominated the previous Prime Minister, Sabah Al Sabah, to be elected Emir. He won the majority of the votes in the parliament and then became the 15th Emir of the state.

Economy

Kuwait has a petroleum-based economy petroleum is the main export product. Kuwait is the second richest GCC (Gulf Cooperation Council) country per capita (after Qatar). Petroleum accounts for half of GDP and 90 % of government income. Non-petroleum industries include financial services. In the past five years, there has been a significant rise in entrepreneurship and small business start-ups in Kuwait.

Despite its relatively small territory, Kuwait has proven crude oil reserves of 104 billion barrels, estimated to be 10 % of the world's reserves. According to the Constitution, all natural resources in the country are state property. During the 1991 Kuwaiti oil fires, more than 500 oil lakes were created covering a combined surface area of about 35.7 km². The oil spills during the Gulf War also drastically affected Kuwait's marine resources.

The Kuwait Investment Authority (KIA) is the world's oldest sovereign wealth fund. Since 1953, the Kuwaiti government has directed investments into Europe, USA and Asia Pacific. As of 2015, the holdings were valued at 592 billion USD in assets. It is the 5th largest sovereign wealth fund in the world. Among KIA's high-profile investments is Daimler AG and BP.

Kuwait is a major source of foreign economic assistance to other states through the Kuwait Fund for Arab Economic Development (<https://www.kuwait-fund.org/en/web/kfund>). In 1974, the fund's lending mandate was expanded to include all developing countries in the world.

Table 3: List of countries by per capita nominal GDP and by GDP per capita

List of countries per capita nominal GDP		
Rank	Country	USD
1	Luxembourg	105,803
2	Switzerland	80,591
-	Macau	77,451
3	Norway	74,941
4	Ireland	70,638
5	Iceland	70,332
6	Qatar	60,804
7	United States	59,501
8	Singapore	57,713
9	Denmark	56,444
10	Australia	55,707
14	Austria	47,290
17	Germany	44,550
21	France	39,869
30	Kuwait	27,319

List of countries by GDP (PPP) per capita (PPP = purchasing power parity)		
Rank	Country	Int. USD
1	Qatar	124,927
-	Macau	114,430
2	Luxembourg	109,192
3	Singapore	90,531
4	Brunei	76,743
5	Ireland	72,632
6	Norway	70,590
7	Kuwait	69,669
8	United Arab Emirates	68,245
9	Switzerland	61,360
-	Hong Kong	61,016
17	Germany	50,206
21	Austria	49,247

Source: International Monetary Fund 2017

1.2. Regulation/laws regarding waste management

The key regulations/laws are

- decision No. 210/2001 Pertaining to the Executive By-Law of the Law of Environment Public Authority, and
- law No. 42 of 2014 Promulgating The Environment Protection Law

In view of focusing attention on the environmental issues, the Government of Kuwait established the Kuwait Environment Public Authority (K-EPA) in 1996 to rehabilitate the national resources and organize the administrative environmental structure of Kuwait.

With the integrated efforts of various institutions that have come together for preservation of environment resulted in passing of a decree in 1980, which enforced the law for protection of the environment. Decision No. 210/2001 represents an executive by-law of the K-EPA pertaining to the Environmental Standards in the state of Kuwait.

Based on Decision No 210/2001 KEPA standards for waste to energy (WtE) plants are shown in the table below.

Appendix No. (11) with the subtitle *Management of Domestic Wastes, Hazardous Wastes, Health Care Wastes and Sludge Wastes* includes for example *The List of Hazardous Characteristics as per Basel Agreement (H1 – H13)*, categories of wastes to be controlled, transportation and disposal of hazardous waste and also the criteria of treated drainage waste water used in irrigation.

Table 4: Main standards for Waste-to-Energy plants in Kuwait

Subject	Appendix and clauses of EPA By-Law	Regulatory bodies
waste management	Appendix 11	
waste disposal	Clause 19-29	Kuwait Municipality
sanitary water standards	Appendix 14	Ministry of Public Works, PAAFR
ambient air quality	Appendix 17	
air pollutant from fixed facility limits	Appendix 20	
noise level limits	Appendix 18	
occupational health exposure	Appendix 6	Ministry of Health (MOH)

The ambient air quality standards regulated in Appendix 17 are comparable to international levels as shown in the table below

Table 5: Ambient air quality standards for residential areas

Pollutant	Unit	hour*		8 hours		day**		year	
		ppb	mg/m ³	ppb	mg/m ³	ppb	mg/m ³	ppb	mg/m ³
Sulfur Dioxide	SO ₂	170	444	-	-	60	157	30	80
Hydrogen Sulphide	H ₂ S	140	200	-	-	30	40	6	8
Nitrogen Dioxide	NO ₂	100	225	-	-	50	112	30	67
Carbon Monoxide	CO	30,000	34,000	10,000	11,500	8,000	9,000	-	-
Ozone	O ₃	80	157	60	120	-	-	-	-
Ammonia	NH ₃	800	850	-	-	-	-	140	148
Hydrocarbon Compounds without Methanes	1/10 from specified rate in works environment (TLV's) 0.24 ppm for three hours from 6:00 – 9:00 morning (a.m)								
Suspended particulate matter	PM-10	-	-	-	-	-	350	-	90
Dust – Fall out Matter		-	-	-	-	-	-	7.5 ton/km ²	
Lead		-	-	-	-	-	-	1.5 mg/m ³	
Chlorine***		30.0 (30 min)	100	-	-	10	30	-	-

* Average hour should not occur more than twice during the period of 30 days on the same site

** Daily average (24 hours) should not occur more than once during the year

*** Should not occur more than once per year

- Should apply in residential dominated areas that lie on the border of industrial areas

Source: Kuwait EPA Act 210, Environmental Public Authority Decision No.210/2001 (2001)

It can be detained that a lot of limits/standards are regulated in the Decision No. 210/2001 even for incineration plants. Article 35 includes the Technical Specifications and Allowed Averages of Emissions from Hazardous Incinerators but there are no specific requirements of Emissions Limit Value (ELV 's) for non-hazardous (municipal solid waste, MSW) incinerators defined on the existing Kuwaiti legislation.

The tender authority has had prepared a comparative study of the regulatory framework for WtE plants according to several relevant national and international standards (EU, Japan, US EPA). As the European Directive (IED) is the one with strictest requirements for waste incineration and the control of pollution it was considered as reference for regulating the ELV's.

2. Actual situation in the field of waste management

According to the studies made for the waste to energy project Kabd tendered in 2015 currently in Kuwait very limited research has been carried out on the sector of waste management and data and information are non-existent in many cases:

The common method of solid waste disposal in Kuwait is still land filling. At the moment with an ongoing improvement to change from uncontrolled land filling sites to controlled dumpsites with the goal to treat non-hazardous waste in state of the art Waste to Energy plants in the future.

The following graphic shows that landfilling is the main method to dispose waste in Kuwait and this is very opposite to other developed markets. [2]

The following figures are mainly extracted from a presentation of the responsible authority in October 2014. The data mentioned there are based on a very detailed survey made by an international consultant by order of this authority. The main object of this study was to determine the current and the future waste composition and quantities for a waste to energy project tendered in 2015.

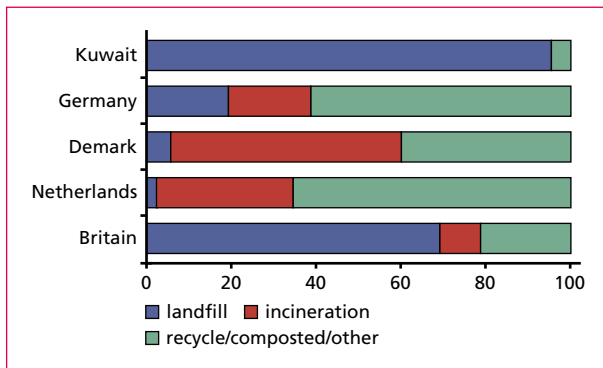


Figure 3:

Comparison of waste disposal methods: Kuwait versus other developed markets

The report considered different socio-economic and building structures like industrial areas, residential areas. The investigations and samplings took place at different times of the year to get an overview even about possible yearly differences.

The amount of waste was estimated

- a) by KM (Kuwait Municipality) on the count of the trucks delivering to the landfills and an average load per truck and

b) waste quantities recorded on the Seven South Ring Road Landfill for 2012 and 2013

The figures were counterchecked with the waste generation rate in kg/capita/day as a reliable and worldwide accepted indicator.

Based on this the yearly amount of waste was defined with 2,018,302 tonnes per year of MSW (91 %) and agricultural waste in 2013 (9 %). This leads to a waste generation rate of 1.5 kg/capita per day. This figure is on the lower end of the range published by the World Bank (2012). For high income countries like Kuwait the range indicated is between 1.1 up to 4.5 kg/capita per day. At the moment the waste is transported and disposed of at three landfills.

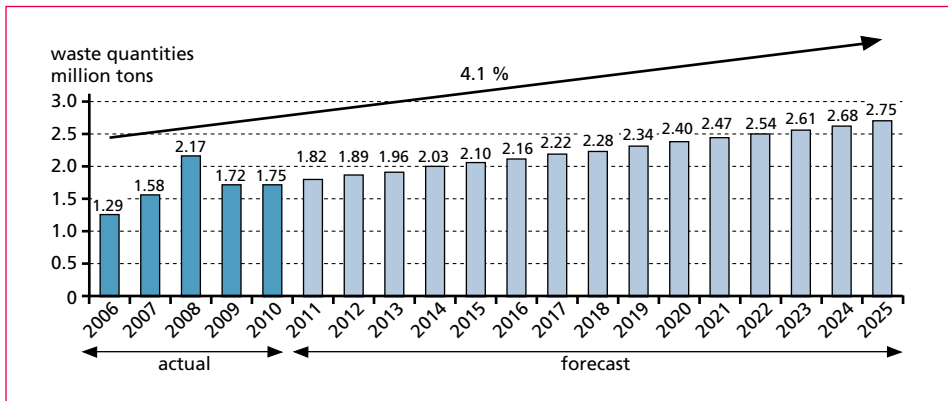


Figure 4: Waste quantities future development – municipal solid waste demand – 2006 to 2025

Source: Kabd Municipal Solid Waste Project_Official Presentation Oct. 2014

At the moment the waste is transported and disposed of at three landfills.

- Seven South Ring Road landfill
- Minaa Abedalla landfill
- Al Jahrah landfill

The above mentioned amount is also the basis to forecast the quantities until 2040. With an estimated population of approximately 7,5 million inhabitants and a corresponding total municipal solid waste quantity of around 4 million tons per year-

Having these figures in mind the projected Kabd – waste to energy plant will be responsible for the state of the art thermal treatment of around one quarter of the total amount of municipal solid waste. The projected plant will therefore in no way contradict any future planned recycling measurements.

Waste quality

Derived from the very comprehensive field investigations and surveys the waste composition was determined as shown in Figure 5.

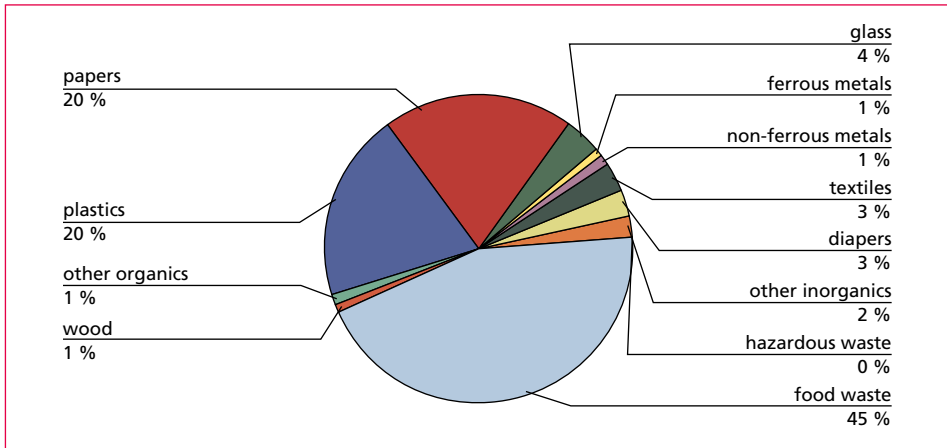


Figure 5: Waste composition in Kuwait

Source: Kabd Municipal Solid Waste Project_Official Presentation Oct. 2014

Low calorific value (LCV)

Calculated LCVs were determined applying the percentage shares of waste composition and moisture and ash content values from laboratory results (values from NAPESCO were applied in all LCV calculations), TA internal data and supported by scholarly literature

The mean LCV of 9,500 kJ/kg was finally determined for the proposed WtE facility

Waste types to be delivered to the proposed waste facility

- waste originated from residential households,
- bulky waste,
- street sweeping waste,
- waste originated from local institutions,
- waste from commercial generators,
- non-hazardous health care waste,
- airport waste similar to waste from residential households,
- industrial waste similar to waste from residential households, and
- agricultural waste.

3. Initiatives

3.1. General initiatives/goals

The Government of Kuwait, in its Development Plan 2010 – 2014, has adopted a PPP programme to develop public infrastructure projects and to introduce private capital and expertise in sectors otherwise under Government control. In support of the PPP programme,

the State of Kuwait has enacted the PPP Law and the Executive Regulations which established KAPP. The responsible agency (KAPP – Kuwait Authority for Partnership Projects) has developed a roadmap that highlights top-priority projects and has identified a total of eight sectors as key sectors. The sectors identified are: communication, education, healthcare, power, real estate, solid waste management, transportation, and water/wastewater.

3.2. Recent initiatives in the field of solid waste management – the Kabd waste to energy project

Technical data

The Site is located in the Kabd area at a distance of approximately 35 km from Kuwait City with an area of 500,000 m². The project's specific approach is based on using WtE technology to generate electricity, recover materials (metals) from bottom ash, and the disposal of the FGT residues and remaining bottom ash.

- MSW capacity of 3,274 tonnes per day (about 1,057,300 tonnes per year), average waste NCV of 9.5 MJ/kg,
- minimum of four lines (approximately 90 MW_{th} per line),
- grate fired technology,
- energy recovery boiler,
- flue gas treatment system in compliance with Directive 2010/75/EU,
- steam turbine with ACC (air cooled condenser),
- metals (ferrous and non-ferrous) recovery from the bottom ash,
- a treatment and maturation plant on site, and
- two separate landfills to be established within the Site, for the controlled disposal of FGT residues and the remaining bottom ash.

Objectives of the Project

- diversion of MSW from landfilling for about half of the waste amount estimated for 2020 (more than two million tons per annum),
- generation of base load renewable energy,
- reduction in greenhouse gas emissions,
- support sustainable waste management, and
- protection of water resources.

The successful bidder will be responsible for the design, build, finance, maintenance, operation (25 years) and transfer of the Facility.

Kuwait Municipality is responsible for the collection and transportation of MSW to the site.

4. References

- [1] Kabd Municipal Solid Waste Project_Official Presentation Oct. 2014
- [2] KPMG Advisory W.L.L., Kuwait: Investing in Kuwait: A guide for Investment Opportunities in Kuwait. Viewed on July 2018: <https://e.kdipa.gov.kw/main/KDIPA-Investment-Guide-2016.pdf>, 2016
- [3] Kuwait EPA Act 210, Environmental Public Authority Decision No.210/2001 (2001)
- [4] Law No. 42 of 2014 Promulgating The Environment Protection Law

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