State of Qatar

Ministry of Development Planning and Statistics

Environment Statistics Annual Report

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Planning and Statistics

1 Foreword

Environmental development is the fourth pillar of the National Development Strategy 2011-2016 (NDS).

To maintain Qatar's natural heritage is not only a cultural and religious responsibility, but also the foundation for healthy land and marine ecosystems which provide lots of services to the society for free. Such ecosystem services include the provision of natural resources (e.g. fish, water, soil) and recreational services for sports, leisure and tourism.

The Ministry of Development Planning and Statistics (MDPS) is publishing this second annual Report on Environment Statistics which not only provides an excellent basis for the Midterm Review of the NDS' environmental targets but also for the information of the general public about the state of the environment in Qatar.

It shows that Qatar has made a lot of progress when it comes to the protection of land and marine ecosystems, wastewater collection and treatment and in facing out substances which are harmful to the ozone layer. However, it also presents that more needs to be done to improve air quality and to protect groundwater resources from depletion.

The report also shows the need to improve overall data quality and to fill data gaps (for example related to solid waste, biodiversity and greenhouse gas emissions) in close cooperation with all governmental and non-governmental key-stakeholders.

The implementation of a national Qatari Framework for Environment Statistics by the MDPS' Section on Environment Statistics and Sustainable Development in 2012 now allows to harvest the first fruits: This Environment Statistics report addresses the information needs of the NDS in the best way possible and follows also international classification standards and indicators to a great extent which is useful for benchmarking on the regional and global level.

All underlying statistics will also be made available on the Qatar Information Exchange Portal (QALAM).

MDPS will continue working in close cooperation with all key-stakeholders to further improve environment statistics of Qatar and to provide the decision makers of this country with a single source of trusted environmental information for knowledge-based decision making and the general public with a comprehensive publication regarding the state of the environment

Dr. Saleh Al-Nabit

Minister of Development
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2 General information

Qatar is situated midway along the western coast of the Arabian gulf between latitudes 24.27˚-26.10˚ North and longitudes 50.45˚– 51.40˚ East. Its surface area is 11,651 km^2, which includes several small islands in the Arabian Gulf such as Halul, Shira'who, Al-Ashat and Al-Bishiria.

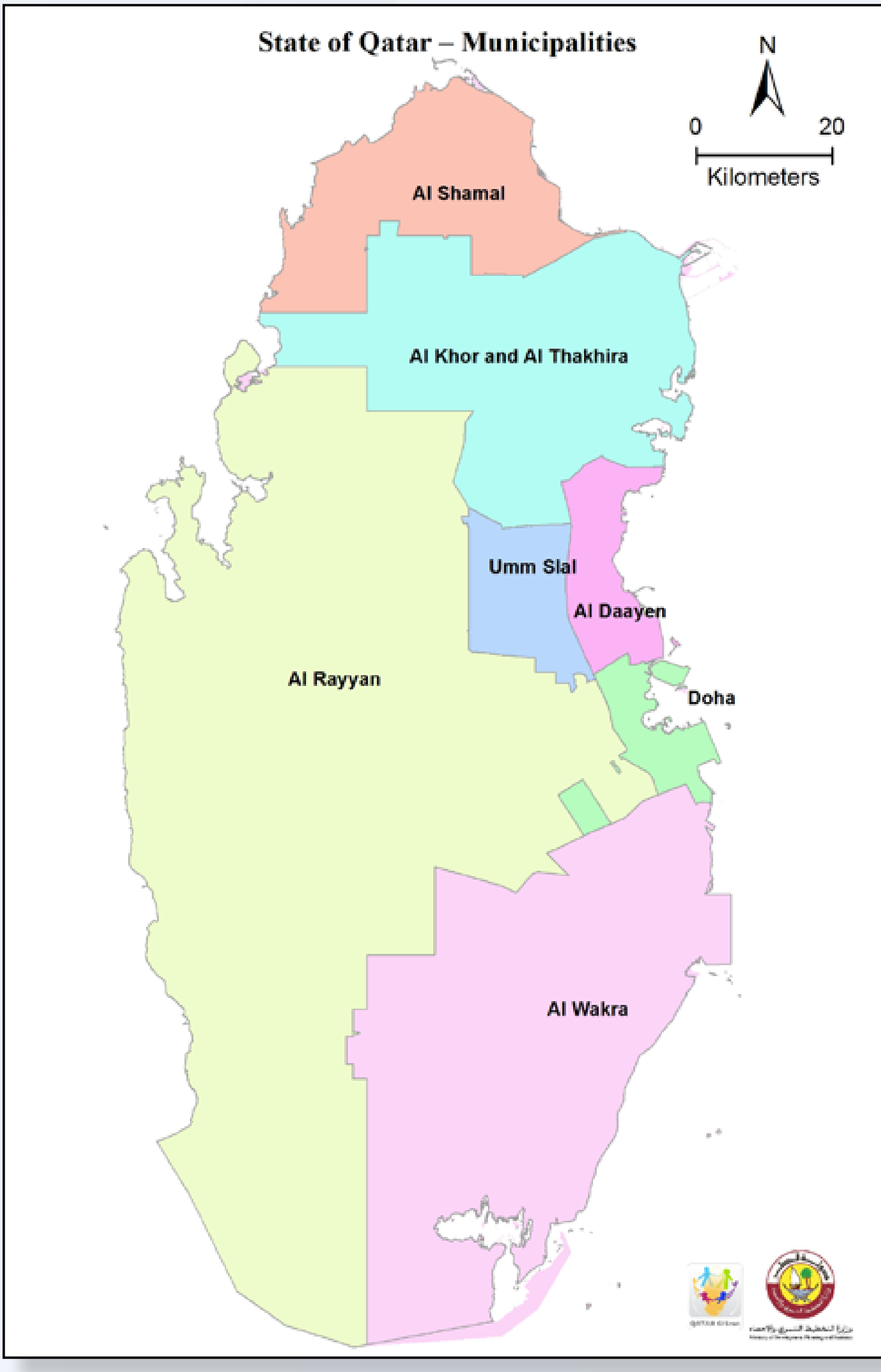
The peninsula is approximately 185 km in length and 85 km in width. The waters of the Arabian Gulf surround by far the majority of the country, while the only land border of about 60 km separates the country from the Kingdom of Saudi Arabia. The United Arab Emirates lie to the east and Bahrain to the northwest of the country.

Qatar generally consists of flat rocky surfaces. It does, however, include some hills which reach and altitude of 100 m above sea level. The majority of the country is sandy desert covered with scrub plants and loose gravel. Moving sand dunes, with an average height of about 40 meters, are found in the southern part of the country, and in the northeastern coast near Ras Laffan.

The northern part of Qatar is relatively low and rises gradually to the west and southwest.

See Map 1.

Map 1: Relief map of Qatar



The main administrative boundaries are those of the 7 municipalities (see Map 2) with Al Rayyan being the largest in area (50% of the national territory) and Doha being the one with the highest population (48% of the total population) and population density (3,645 persons/km^2). See also Table 1.

Map 2: Municipalities of Qatar

Source: MMUP

Table 1: Municipalities of Qatar with their surface area and population (2012)

Municipality	Area (km^2)	Population (2012)	Population density (population/km^2)
Doha	234.8	855,849	3,645.0
Al Rayyan	5,819.5	485,373	83.4
Al Wakrah	2,535.8	182,550	72.0
Um Slal	317.9	66,830	210.2
Al Khor	1,561.4	138,717	88.8
Al Shammal	898.8	6,648	7.4
Al Dayyen	238.6	55,551	232.8
Total	**11,606.8**	**1,791,518***	**154.4**

*Slightly differing from mid-year population as this is based on a sample survey.

Data source: MDPS

3 Climate

3.1 Rationale

The climate of Qatar is characterized by intense heat in the summer with a mean air temperature in the month of July of 35.1˚C. The highest measured temperature was in July 2000 with 49.6˚C[1].

Humidity can also be very high and can even occur in combination with high temperatures.

The long-term annual precipitation in Qatar is 75.2 mm[2] (Doha Airport) which is one of the lowest of all countries in the world.

These extreme conditions make Qatar vulnerable for impacts of climate change, including the possibility of long and intense heat waves, increased desertification of agricultural land and adverse impacts on land and marine ecosystems.

For this report the Qatar Meteorological Department provided data of 5 monitoring stations for the years 2008-2012.

1 http://www.caa.gov.qa/en/climate_information#Feb

2 Qatar Meteorological Department and World Meteorological Organization. Time series 1996-1992)

Map 3: Location of the 5 meteorological stations which are used in this report for statistics about the climate

Data source: QMD

3.2 Temperature and humidity

3.2.1 Key messages

a) In 2012 the hottest month was July with an average maximum daily temperature of 43.3˚C measured at Doha International Airport. This is 1.8˚C more than the long-term average (1962-1992)

b) In Doha the hottest day of the year 2012 was 18 June, with a maximum temperature of 47.7˚ C measured on that day. The coldest day in 2012 was 23 January 2012 with 8.6˚C.

c) The average daily minimum and maximum temperatures of the month of August from 2008-2012 were higher than the corresponding long-term average (1962-1992).

d) Extreme temperatures of 45˚ C and more are most likely in the month of May – August. In 2012 17 days (1 in May, 6 in June, 8 in July and 2 in August) had maximum temperatures of 45˚C and above.

e) The highest temperature observed in Qatar was 49.6˚C in July 2000.

f) In 2012 the highest average monthly relative humidity was observed in Doha with 88% in January and December. In Doha the months with the lowest average monthly relative humidity was June with 29%.

3.2.2 Statistics and indicators

Table 2 presents the average daily minimum and maximum temperatures per month for selected stations across the State of Qatar.

Station Al Karanaaha shows the highest average daily temperatures throughout almost all months of the year. The hottest month was July 2012 with an average maximum daily temperature of 45.3˚ C in Al Karanaaha and 43.3˚C in Doha (International Airport).

In 2012 also the lowest average monthly temperature was observed in Al Karanaaha with 10.6˚C in January.

See Figure 1.

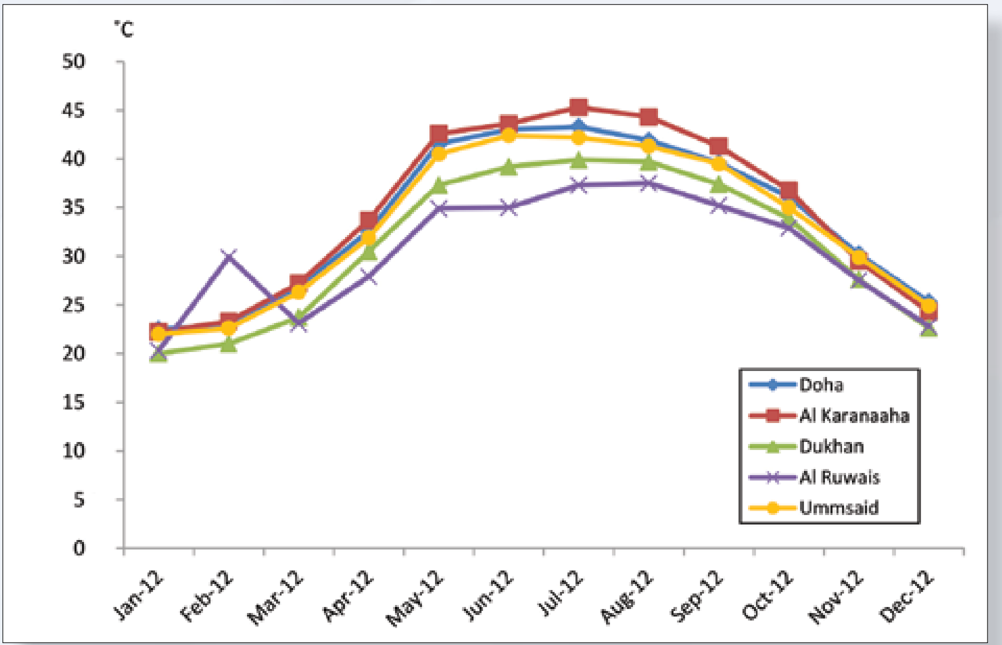
At Doha International Airport both the average minimum and maximum daily temperatures were higher than the long-term averages observed 1962-1992 (only exception is month of February). In 2012 the average maximum daily temperature of the month of July was 43.3˚ C which is 1.8˚ C more than the long-term average (1996-1992).

Table 2: Average daily minimum and maximum temperatures (˚C) on selected stations in Qatar and 31 years average (1962-1992) daily temperatures at Doha International Airport

Station	˚C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Doha International Airport (average 1962-1992)	Min	12.8	13.7	16.7	20.6	25.0	27.7	29.1	28.9	26.5	23.4	19.5	15.0
	Max	21.7	23.0	26.8	31.9	38.2	41.2	41.5	40.7	38.6	35.2	29.5	24.1
Doha International Airport (2012)	Min	14.3	15.2	17.4	23.4	30.1	31.2	32.8	32.9	30.6	27.7	23.2	18.6
	Max	22.5	22.9	26.8	32.6	41.5	43.0	43.3	41.9	39.6	36.1	30.2	25.3
Al Karanaaha (2012)	Min	10.6	11.6	14.3	20.6	26.5	27.4	29.3	29.2	26.3	22.6	18.7	14.6
	Max	22.2	23.3	27.2	33.7	42.6	43.6	45.3	44.3	41.3	36.8	29.5	24.3
Dukhan (2012)	Min	13.4	14.2	16.6	21.1	27.7	28.3	30.3	30.1	28.0	24.4	21.2	16.9
	Max	20.0	21.0	23.7	30.5	37.3	39.2	39.9	39.7	37.4	33.9	27.6	22.6
Al Ruwais (2012)	Min	15.2	15.5	17.2	22.3	28.4	29.6	31.1	31.0	29.8	26.1	22.8	14.2
	Max	20.3	29.9	23.1	27.9	34.9	35.0	37.3	37.5	35.2	32.9	27.5	22.8
Ummsaid (2012)	Min	11.7	13.3	15.9	21.7	27.1	27.3	29.8	29.9	27.0	24.5	20.4	15.7
	Max	22.0	22.6	26.3	31.9	40.5	42.4	42.2	41.3	39.5	35.0	29.9	24.9

Data sources: QMD and WMO (http://www.worldweather.org/116/c00221.htm)

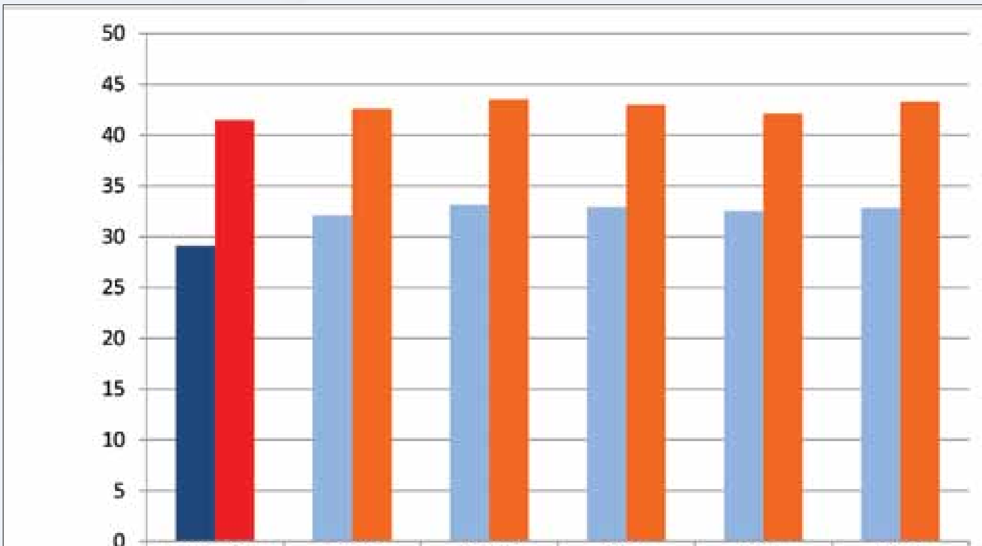
Figure 1: Average daily maximum temperatures per month in 2012



Data source: QMD

Figure 2 compares the average daily minimum and maximum temperatures in July at Doha International Airport 2008-2012 with the corresponding long-term average temperatures (1962-1992). It can be seen that from 2008-2012 both the minimum and the maximum temperature are higher than the long-term average.

Figure 2: Average daily minimum and maximum temperatures in July at Doha International Airport 2008-2012 compared with the long-term average temperature (1962-1992)



	1962-1992	2008	2009	2010	2011	2012
Min (˚C)	29.1	32.1	33.1	32.9	32.5	32.8
Max (˚C)	41.5	42.6	43.5	43.0	42.1	43.3

Data source: QMD

Table 3 presents the absolute maximum and minimum temperatures measured at Doha International Airport in 2012. The hottest day of the year 2012 was 18 June with a maximum temperature of 47.7˚C. The coldest measured temperature was on 23 January 2012 with 8.6˚C. Temperatures of 40˚C and above were measured on 103 days of which 17 days between May and August reached temperatures of 45˚C and more.

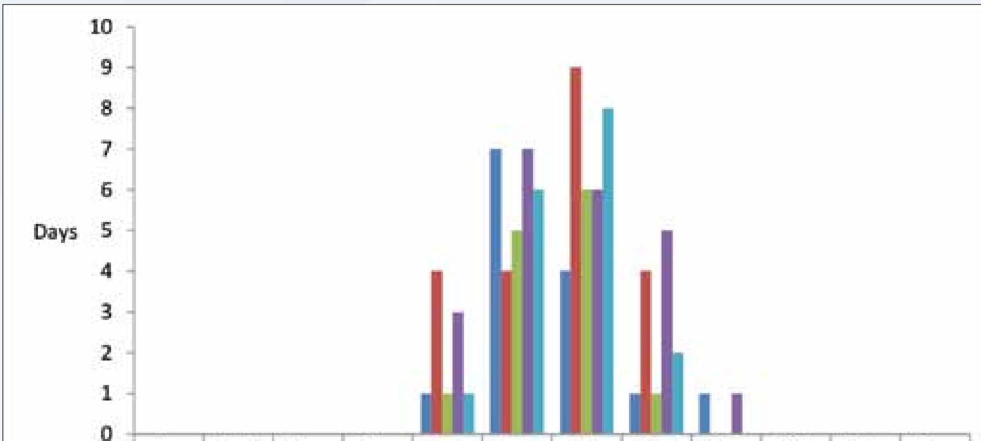
Table 3: Maximum and minimum temperatures measured in 2012 (Doha International Airport)

Month (year 2012)	Extreme temperatures		Number of days with						
	Absolute Max. (˚C)	Absolute Min. (˚C)	Max. Temp.					Min. Temp.	
			>= 25˚C	>= 30˚C	>= 35˚C	>= 40˚C	>= 45˚C	<= 5˚C	<= 10˚C
January	28.0	8.6	5	0	0	0	0	0	2
February	29.8	11.5	4	0	0	0	0	0	0
March	37.8	12.8	19	5	2	0	0	0	0
April	39.8	19.5	30	25	7	0	0	0	0
May	46.8	27.2	31	31	31	4	1	0	0
June	47.7	27.6	30	31	30	28	6	0	0
July	47.6	30.0	31	30	31	31	8	0	0
August	46.1	29.6	31	31	31	23	2	0	0
September	43.5	25.5	30	30	30	15	0	0	0
October	40.5	25.8	31	31	19	2	0	0	0
November	35.0	18.4	8	17	1	0	0	0	0
December	31.3	14.3	16	1	0	0	0	0	0
Annual	**47.7**	**8.6**	**266**	**232**	**182**	**103**	**17**	**0**	**2**

Data source: QMD

In the period from 2008-2012 extreme temperatures of >= 45˚C occurred in all months May – August (Doha International Airport), with July 2009 being the hottest month of those years (9 days with 45˚C or more). See Figure 3.

Figure 3: Number of days per month and year (2008 – 2012) with temperatures >= 45˚C at Doha International Airport



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0	0	0	0	1	7	4	1	1	0	0	0
2009	0	0	0	0	4	4	9	4	0	0	0	0
2010	0	0	0	0	1	5	6	1	0	0	0	0
2011	0	0	0	0	3	7	6	5	1	0	0	0
2012	0	0	0	0	1	6	8	2	0	0	0	0

Data source: QMD

The average monthly maximum humidity was highest in Al Ruwais and Dukhan most of the months. In 2012 in Doha the average relative humidity was highest in January and December (88%) whereas the lowest average relative humidity was observed in June (66%). See Table 4.

Table 4: Average relative humidity (%) in 2012

Station	%	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Doha International Airport	Min	60	59	49	42	34	29	34	43	43	47	55	62
	Max	88	87	82	71	71	66	73	80	77	82	82	88
Al Karanaaha	Min	32	27	19	14	7	6	7	11	9	16	29	40
	Max	90	88	80	63	59	54	67	78	83	81	84	89
Dukhan	Min	49	44	39	26	24	19	26	21	27	36	47	59
	Max	84	83	80	79	74	77	79	82	80	84	82	85
Al Ruwais	Min	58	55	53	47	41	48	50	51	55	51	58	66
	Max	85	86	84	78	76	79	82	85	80	86	84	89
Ummsaid	Min	45	42	25	23	13	10	19	30	24	38	39	47
	Max	86	83	78	65	65	64	72	80	79	81	80	87

Data source: QMD

3.3 Precipitation

3.3.1 Key messages

a) Rainfall is most likely in the months of December – April.

b) In the years 2008 – 2012 the total precipitation (monitored at Doha International Airport) was lower than the long-term average precipitation (1962-1992). In the year 2012 the total precipitation was 32% of the long-term average.

3.3.2 Statistics and Indicators

Compared to the long-term average (1962-1992) 2012 was a relative dry year with a total precipitation of 23.9 mm at Doha International Airport. This is only 32% of the long-term average precipitation.

In 2012 the highest annual precipitation was measured in Al Ruwais (40.0 mm) and the lowest in Ummsaid (17.6 mm).

No precipitation was observed throughout Qatar from May – September 2012. See Table 5.

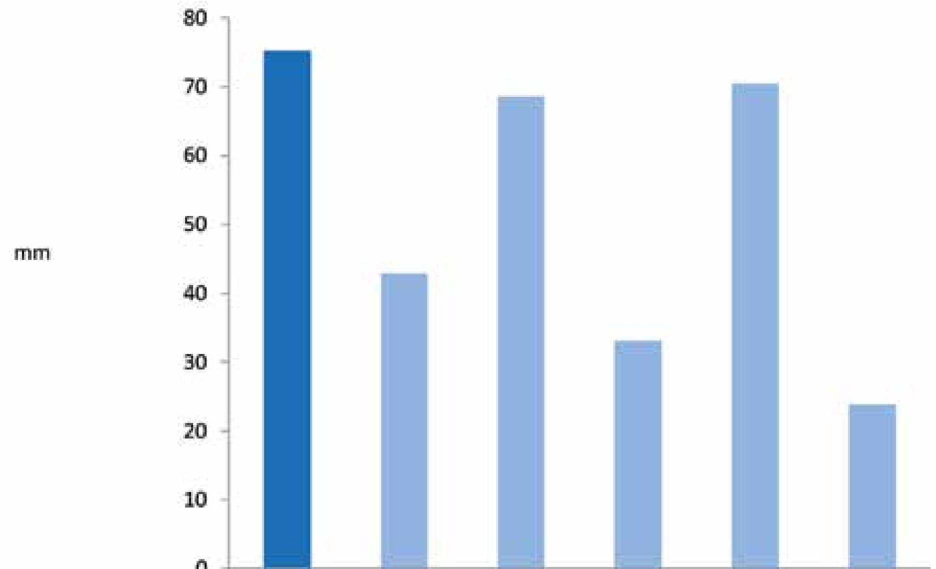
Table 5: Precipitation (mm) at selected monitoring stations in Qatar in 2012 and the long-term averages (1962-1992) for Doha International Airport

Station (precipitation in mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Doha International Airport (1962-1992)	13.2	17.1	16.1	8.7	3.6	0.0	0.0	0.0	0.0	1.1	3.3	12.1	**75.5**
Doha International Airport (2012)	0.0	0.0	4.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	**23.9**
Al Karanaaha (2012)	1.4	0.6	4.8	15.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	10	**32.9**
Dukhan (2012	0.8	0.6	10.6	7.8	0.0	0.0	0.0	0.2	0.0	0.2	0.2	15.4	**35.8**
Al Ruwais (2012)	0.6	2.6	9.8	4.0	0.0	0.0	0.0	0.0	0.0	0.4	6.2	16.4	**40.0**
Ummsaid (2012)	1.0	0.0	2.4	5.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	8.0	**17.6**

Data source: QMD

Figure 4 shows that the annual precipitation in all years from 2008 – 2012 was lower than the annual average precipitation (1962-1992).

Figure 4: Annual precipitation at Doha International Airport 2008-2012 compared with the long-term annual precipitation (1962-1992)



	1962-1992	2008	2009	2010	2011	2012
Annual precipitation (mm)	75.2	42.9	68.6	33.1	70.5	23.9

Data source: QMD

4 Ambient air quality

The national quality standards for ambient air quality are laid down in the Executive By-Law for The Environment Protection Law 30/2002.

Table 6 presents the national quality standards and the corresponding guidance values of the World Health Organization (WHO, 2011). It can be seen that most of the national quality standards set limits above the recommended guidance values of the WHO.

Table 6: Ambient air quality standards for main pollutants: National standards (Qatar) and WHO guidance values (WHO, 2011)

Pollutant	Unit	Concentration averaged over									
		10 minutes		1 hour		8 hours		24 hours		1 year	
		Qatar	WHO	Qatar	WHO	Qatar	WHO	Qatar	WHO	Qatar	WHO
Sulfur dioxide (SO_2)	µg/m³		500					365	20	80	
Nitrogen dioxide (NO_2)	µg/m³			400	200			150		100	40
Ground Level Ozone (O_3)	µg/m³			235		120	100				
Carbon Monoxide (CO)	mg/m³			40	30	10	10				
Particulate Matter (PM_{10})	µg/m³							150	50	50	20
Particulate Matter ($PM_{2.5}$)	µg/m³								25		10

Data sources: Executive By-Law for The Environment Protection Law 30/2002 and WHO (2011)

The Qatar National Development Strategy calls for measures to improve the ambient air quality and sets the target to eliminate instances of excess ozone levels.

Data of the 3 monitoring stations Movenpick (close to Corniche), Qatar University and Aspire Zone for the years 2008 – 2012[3] are available.

[3] Data for concentrations of air pollutants and number of days of exceeding concentrations were provided by the Ministry of Environment for the years 2008-2012.

Currently monitoring data is available for:

- Ground Level Ozone (O_3)
- Particulate Matter (PM_{10})
- Sulfur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Carbon Monoxide (CO)

Data source for all air quality data used in this report is the Ministry of Environment.

4.1 Overall key messages

a) Most of the national ambient air quality standards allow higher average concentrations for ambient air pollution than recommended by the guidance values of the World Health Organization (WHO). For example the national air quality standard for PM_{10} is 50 $\mu g/m^3$ whereas the guidance value of the WHO is only 20 $\mu g/m^3$ for the average annual concentration.

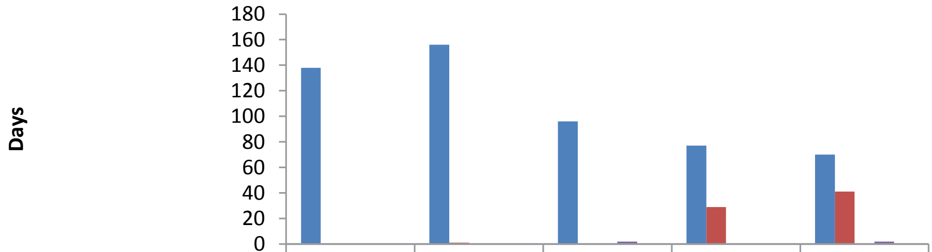
b) The national quality standards are frequently exceeded for particulate matter and ground-level ozone (e.g. in 2012 the air quality standard for PM_{10} was exceeded on 70 days (which is an improvement compared with 138 days in 2008), for ground level ozone on 41 days at Movenpick monitoring station).

c) Since 2008 the total number of days on which nitrogen dioxide concentrations were above the national air quality standards was 4 (2 in 2010 and 2 in 2012 at Movenpick). However, annual average nitrogen dioxide concentrations exceeded the WHO guidance value of 40 $\mu g/m^3$ in all years since 2008, with the exception of the year 2011.

d) Concentrations of sulfur dioxide and carbon monoxide are continuously below the national air quality standards.

Figure 5 presents the days per year on which air quality standards were exceeded for the individual pollutants from 2008-2012.

Figure 5: Number of days per year on which the national air quality standards were exceeded per pollutant (monitoring station Movenpick)



	2008	2009	2010	2011	2012
Particulate Matter (PM10)	138	156	96	77	70
Ground Level Ozone (O3)	0	1	0	29	41
Sulfur dioxide (SO2)	0	0	0	0	0
Nitrogen dioxide (NO2)	0	0	2	0	2
Carbon Monoxide (CO)	0	0	0	0	0

Data source: MoE

4.2 Ground level ozone

4.2.1 Rationale

Ground level or “bad” ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOC. (EPA, 2013)

The target of the QNDS 2011-2016 is to eliminate instances of excess ozone levels through improved air quality management.

The national air quality standards (Environmental Protection Law 30/2002) are 235 µg/m^3 for the 1 hour average concentration and 120 µg/m^3 for the 8 hours average concentration. The WHO guideline value (WHO, 2011) for ground-level ozone is 100 µg/m^3 for the 8 hours average concentration, thus lower than the nationally applied standard.

4.2.2 Key messages

a) From 2008 until 2012 the number of days where the quality standards of 235 µg/m^3 (1 hour average) or 120 µg/m^3 (8 hour average) were exceeded have increased in all three monitoring stations Movenpick, Aspire Zone and Qatar University.

b) The months where an exceedance of the quality standards is most likely are June and July.

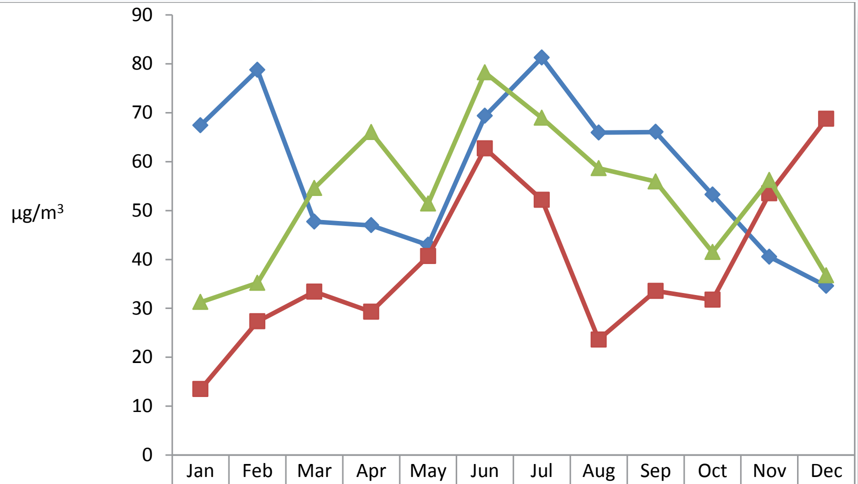
c) The highest measured value of ground level ozone in 2012 (8 hour period) was 235.88 µg/m^3 (measured in July).

d) In the year 2012 monitoring station Movenpick had the highest monthly average concentration of all three monitoring stations in most of the months. It also showed the highest average annual concentration.

4.2.3 Statistics and indicators

The monthly average concentrations of ground level ozone per monitoring station in the year 2012 are presented in Figure 6. It shows that all three stations observed high concentrations in the months of June and July. Movenpick shows the highest monthly average concentrations most of the months. The highest 8 hours average concentration of ground level ozone was measured on a single day in July with 235.88 µg/m^3.

Figure 6: Average monthly concentrations of ground level ozone (µg/m³) in 2012 per monitoring station

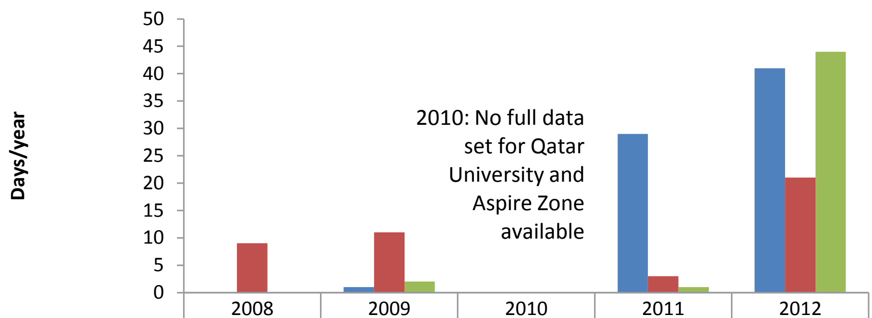


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Movenpick	67.42	78.73	47.71	46.96	42.97	69.33	81.26	65.93	66.05	53.22	40.53	34.55
Qatar University	13.47	27.32	33.39	29.29	40.66	62.68	52.17	23.60	33.54	31.73	53.48	68.71
Aspire Zone	31.28	35.19	54.59	66.00	51.37	78.20	68.93	58.64	55.92	41.48	56.22	36.70

Data source: MoE

The number of days on which the quality standards for ground level ozone were exceeded has increased from 2008 until 2012 in all 3 monitoring stations (see Figure 7).

Figure 7: Number of days with exceedances of quality standards for ground level ozone

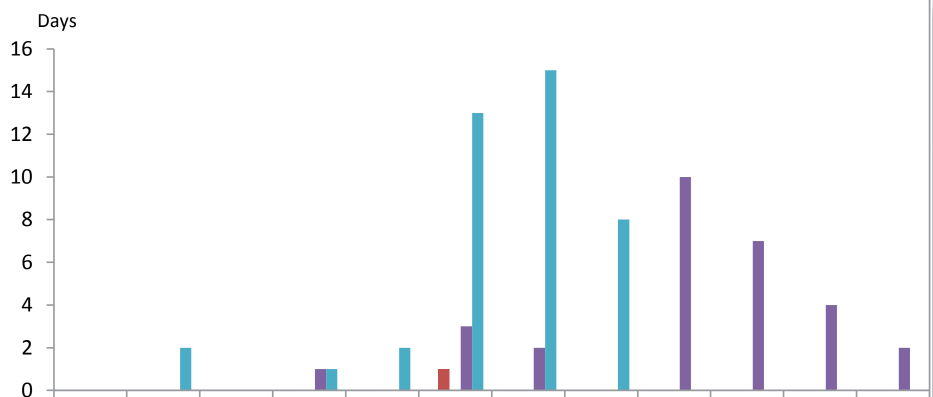


	2008	2009	2010	2011	2012
Movenpick	0	1	0	29	41
Qatar University	9	11		3	21
Aspire Zone	0	2		1	44

Data sources: MoE (data for 2008 – 2012), GSDP (2011) (data for 2007)

Figure 8 presents the distribution of days of exceedances of ozone quality standards per month at monitoring station Movenpick for the years 2008-2012[4]. The months with the highest number of days with exceedances of the quality standards for ground level ozone are June and July.

Figure 8: Days of exceedance of quality standards per month for ground level ozone (Movenpick monitoring station)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	1	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	1	0	3	2	0	10	7	4	2
2012	0	2	0	1	2	13	15	8	0	0	0	0

Data source: MoE

4.3 Particulate Matter

4.3.1 Rationale

Particulate matter (PM) is an air pollution term for a mixture of solid particles and liquid droplets found in the air. The pollutant comes in a variety of sizes and can be composed of many types of materials and chemicals. Particles that are small enough to be inhaled have the potential to cause health effects. Of particular concern is a class of particles known as fine particulate matter or $PM_{2.5}$ that gets deep into the lung.

[4] Longest not interrupted time series of the 3 monitoring stations is available for Movenpick

The air pollutant can originate from natural processes, like forest fires and wind erosion, and from human activities, like agricultural practices, smokestacks, car emissions, and construction. Examples include dust, dirt, soot, soil, and smoke. (EPA, 2013)

The national air quality standards (Environmental Protection Law 30/2002) for PM_{10} are 150 µg/m^3 for the 24 hours average concentration and 50 µg/m^3 for the annual average concentration. The corresponding WHO guidelines are 50 µg/m^3 for the 24-hour average and 20 µg/m^3 for the annual average concentration, thus lower than the nationally applied standards.

Currently there is no quality standard for $PM_{2.5}$, the WHO guideline is 25 µg/m^3 for the 24-hour average and 10 µg/m^3 for the annual average concentration (WHO, 2011).

For Doha currently only data about PM_{10} is available, the monitoring of $PM_{2.5}$ has started recently.

4.3.2 Key messages

a) In the year 2012 monitoring station Qatar University in most of the months had the highest monthly average concentrations for both PM_{10} and $PM_{2.5}$.

b) For PM_{10} since 2008 Qatar University monitoring station shows the highest annual average concentrations of all three monitoring stations. It also showed the highest annual average concentration for $PM_{2.5}$ in the year 2012.

c) For PM_{10} both the national quality standard of 50 μg/m^3 and the WHO guideline value of 20 μg/m^3 (annual average concentration) are exceeded in all three monitoring stations since beginning of the measurements (2008).

d) The highest measured concentrations of 24 hours average concentrations in 2012 of both PM_{10} and $PM_{2.5}$ occurred at Qatar University monitoring station. It was 2,214 µg/m^3 for PM_{10} (March 2012) and 1,344 µg/m^3 for $PM_{2.5}$ (April 2012).

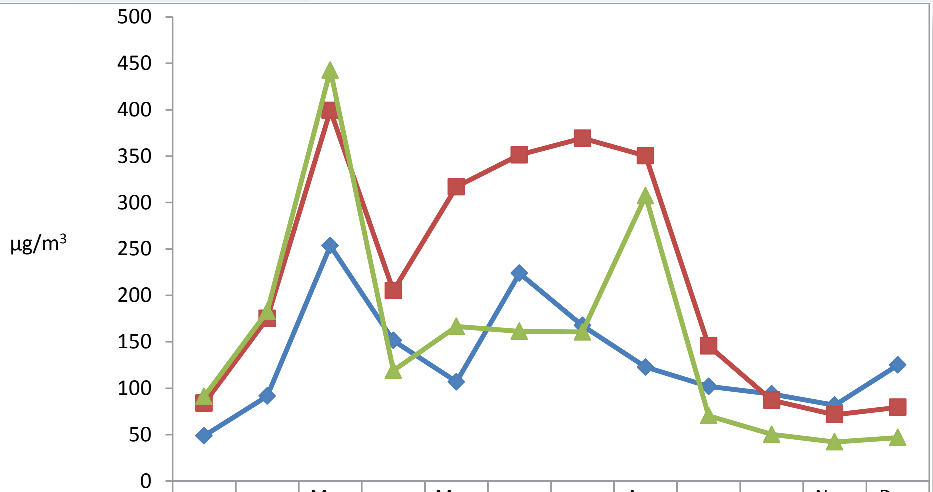
e) For PM_{10} the daily quality standard of 150 µg/m^3 is exceeded several days per month since 2008 (with some exceptions in the months of September and December). Since 2008 the highest number of days exceeding this threshold occurred in the months June and July whereas the lowest number of days with exceedances where in November and December.

f) For $PM_{2.5}$ currently no national quality standard exists. However, compared to the WHO guidance value of 10 µg/m^3 (annual average concentration) all three monitoring stations in Doha exceeded this value.

4.3.3 Statistics and indicators

The monthly average concentrations of PM_{10} per monitoring station in the year 2012 are presented in Figure 9. Of the 3 monitoring stations Qatar University shows the highest monthly average concentrations most of the months as well as the highest average annual concentration (219.57 µg/m^3). The highest 24 hours average concentration of PM_{10} was measured in March with 2,214 µg/m^3 (Qatar University).

Figure 9: Average monthly concentrations of PM_{10} (µg/m³) in 2012 per monitoring station

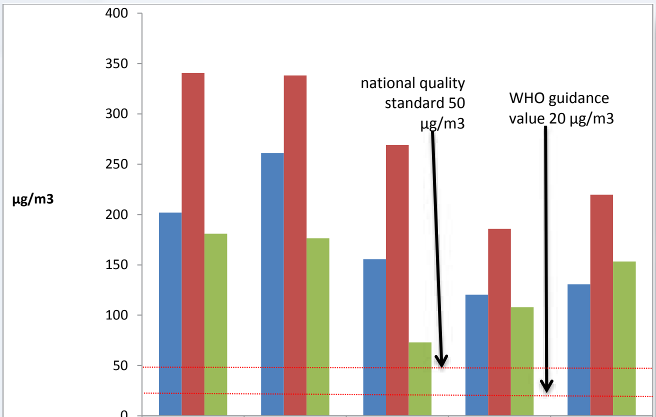


	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Movenpick	48.74	91.54	253.49	151.36	106.95	223.77	167.54	122.68	101.96	93.87	81.84	125.00
Qatar University	83.79	175.10	399.19	204.99	317.10	351.40	369.28	350.34	145.65	87.01	71.48	79.50
Aspire Zone	91.16	182.39	442.72	118.99	166.62	161.30	160.59	307.25	70.36	50.19	42.10	46.86

Data source: MoE

Figure 10 presents a time series of the average annual concentrations of PM_{10} from 2008 – 2012. It shows that both the national quality standard of 50 µg/m³ and the WHO guidance value of 20 µg/m³ are exceeded. The highest annual average concentrations of PM_{10} are observed at Qatar University.

Figure 10: Annual average concentrations of PM_{10} in the years 2008-2012 in comparison to the national quality standard (50 µg/m³ annual average concentration) and the WHO guidance value (20 µg/m³ annual average concentration)

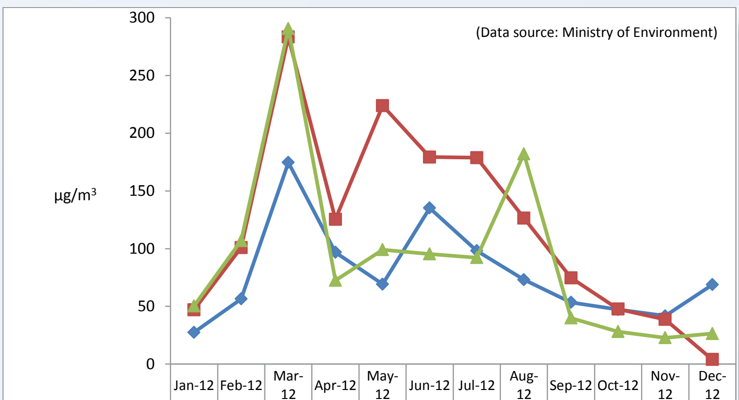


	2008	2009	2010	2011	2012
Movenpick	201.90	261.00	155.72	120.40	130.73
Qatar University	340.60	338.10	269.20	185.85	219.57
Aspire Zone	181.00	176.40	73.06	107.94	153.38

Data source: MoE

Average monthly concentrations of $PM_{2.5}$ for the year 2012 are presented in the Figure 11. It shows that most of the months the highest monthly concentrations occur at Qatar University.

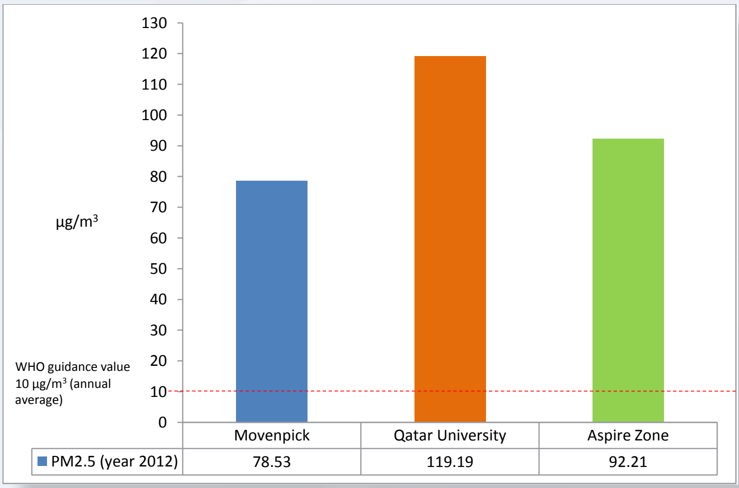
Figure 11: Average monthly concentrations of $PM_{2.5}$ (µg/m³) in 2012 per monitoring station



	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Movenpick	27.50	56.46	174.60	96.80	69.19	135.18	98.20	73.11	53.47	47.23	41.76	68.81
Qatar University	47.02	100.90	283.32	125.44	223.87	179.32	178.81	126.51	74.73	47.62	38.71	4.00
Aspire Zone	50.43	106.96	290.61	72.50	99.07	95.36	92.18	182.11	39.95	28.08	22.82	26.48

Data source: MoE

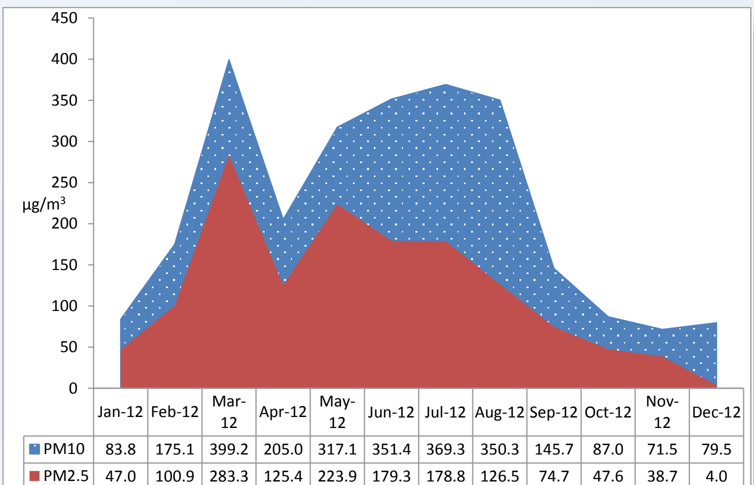
Figure 12: Annual average concentrations of $PM_{2.5}$ of the year 2012 in comparison to the WHO guidance value (10 µg/m³ annual average concentration).



Data source: MoE

Figure 13 overlaps average monthly concentrations of $PM_{2.5}$ with average monthly concentrations of PM_{10} at Qatar University. It shows that in most cases observed high concentrations of PM_{10} are associated with a corresponding high concentration of the $PM_{2.5}$ sub-fraction.

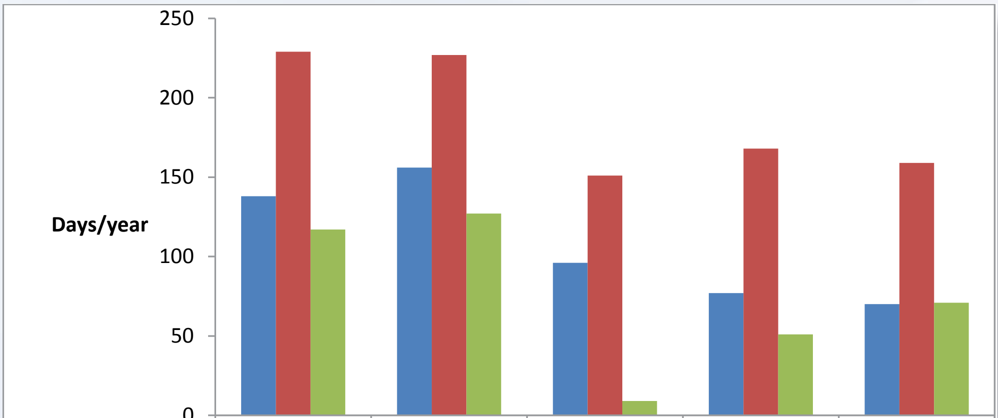
Figure 13: Comparison of the average monthly concentrations of $PM_{2.5}$ and PM_{10} in 2012 at Qatar University



Data source: MoE

The number of days on which the quality standards for PM_{10} were exceeded was the highest at Qatar University in the years 2008-2012. In 2008 the national quality standard of 150 µg/m³ (24 hours average concentration) was exceeded on 229 days (63% of the days of the year), whereas in the year 2012 the quality standard was exceeded on 159 days (44% of the days of the year). See Figure 14.

Figure 14: Number of days with exceedances of quality standards PM_{10}

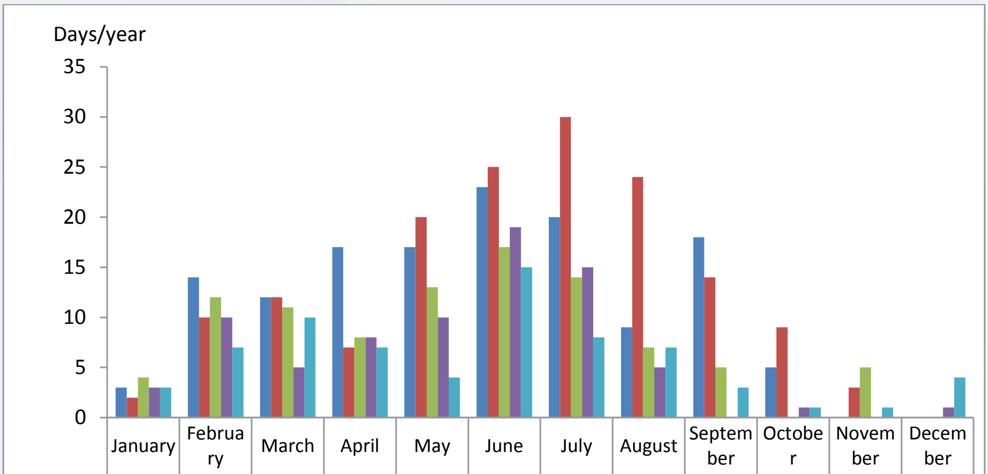


	2008	2009	2010	2011	2012
Movenpick	138	156	96	77	70
Qatar University	229	227	151	168	159
Aspire Zone	117	127	9	51	71

Data sources: MoE

Figure 15 presents the distribution of days of exceedances of the PM_{10} quality standard per month at monitoring station Movenpick for the years 2008-2012. The months with the highest number of days with exceedances of the quality standards for PM_{10} are June and July.

Figure 15: Days of exceedance of quality standards per month for PM_{10} (Movenpick monitoring station)



	January	February	March	April	May	June	July	August	September	October	November	December
2008	3	14	12	17	17	23	20	9	18	5	0	0
2009	2	10	12	7	20	25	30	24	14	9	3	0
2010	4	12	11	8	13	17	14	7	5	0	5	
2011	3	10	5	8	10	19	15	5	0	1	0	1
2012	3	7	10	7	4	15	8	7	3	1	1	4

Data source: MoE

4.4 Sulfur dioxide

4.4.1 Rationale

Sulfur dioxide (SO_2) is one of a group of highly reactive gasses known as "oxides of sulfur." The largest sources of SO_2 emissions are from fossil fuel combustion at power plants and other industrial facilities. Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a number of adverse effects on the respiratory system. (EPA, 2013)

The national air quality standards (Environmental Protection Law 30/2002) are 365 µg/m^3 for the 24 hours average concentration and 80 µg/m^3 for the annual average concentration. The corresponding WHO guideline values are 500 µg/m^3 for the 10-minute average and 20 µg/m^3 for the 24-hour average concentration (WHO, 2011), thus significantly lower than the nationally applied standard.

4.4.2 Key messages

a) The observed concentrations of Sulfur dioxide in ambient air quality are continuously below the national quality standards. There has been no observed exceedance of the quality standards since the year 2008 (begin of data availability).

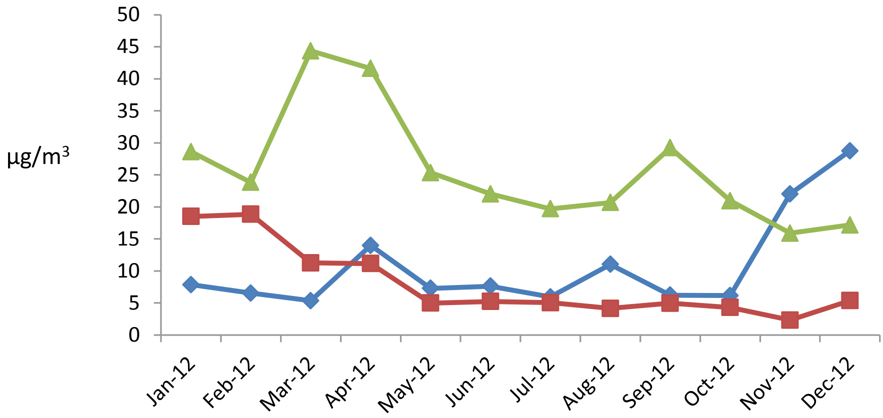
b) Annual average concentrations since 2008 are below the national quality standard of 80 µg/m^3.

c) The only increase of annual average concentrations (2008-2012) can be observed at monitoring station Aspire Zone. However, the observed values are well below the national quality standard.

4.4.3 Statistics and indicators

Figure 16 shows that from the 3 air quality monitoring stations the highest monthly concentrations of SO_2 are observed in Aspire Zone. The highest concentration (24 hours average) of the year 2012 was observed in Aspire Zone on 17th March with 104.34 µg/m^3 which is still below the national quality standard of 365 µg/m^3 (24 hours average).

Figure 16: Average monthly concentrations of SO_2 (µg/m³) in 2012 per monitoring station

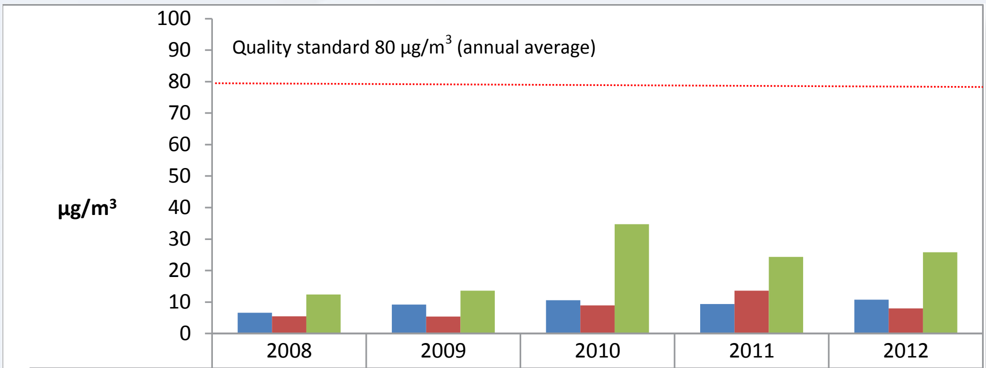


	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Movenpick	7.85	6.53	5.35	13.98	7.29	7.63	5.94	11.03	6.23	6.15	22.03	28.75
Qatar University	18.51	18.86	11.25	11.15	4.98	5.24	5.06	4.16	4.97	4.30	2.32	5.36
Aspire Zone	28.62	23.83	44.36	41.61	25.33	22.02	19.70	20.69	29.24	20.95	15.90	17.17

Data source: MoE

The annual average concentrations are below the national quality standard of 80 µg/m³ for all years since 2008. Aspire Zone show the highest annual average concentrations of al 3 monitoring stations which has increased from 12.40 µg/m³ in 2008 to 25.79 µg/m³ in 2012. See Figure 17.

Figure 17: Annual average concentrations of SO_2 in the years 2008-2012 in comparison to the national quality standard (80 µg/m³ annual average concentration)



	2008	2009	2010	2011	2012
Movenpick	6.60	9.16	10.56	9.32	10.73
Qatar University	5.50	5.40	8.92	13.56	8.01
Aspire Zone	12.40	13.60	34.68	24.29	25.79

Data source: MoE

4.5 Nitrogen dioxide

4.5.1 Rationale

Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as "oxides of nitrogen," or "nitrogen oxides (NO_x)." Other nitrogen oxides include nitrous acid and nitric acid. It is used as an indicator for the larger group of nitrogen oxides. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system (see EPA, 2013).

The national air quality standards (Environmental Protection Law 30/2002) are 400 µg/m³ for the 1 hour average concentration, 150 µg/m³ for the 24 hours average concentration and 100 µg/m³ for the annual average concentration. The corresponding WHO guideline values are 200 µg/m³ for the 1-hour average and 40 µg/m³ for the annual average concentration (WHO, 2011), thus lower than the nationally applied standard.

4.5.2 Key messages

a) The observed concentrations of nitrogen dioxide in ambient air quality are below the national quality standards more than 99% of the days per year.

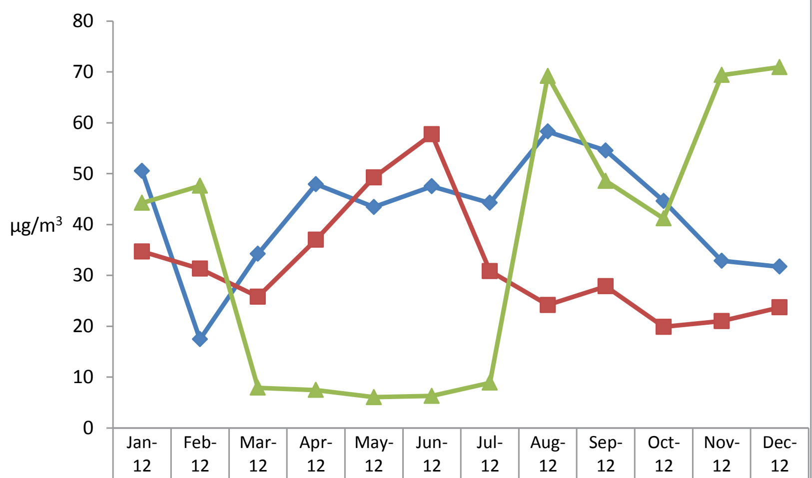
b) Annual average concentrations since 2008 are below the national quality standard of 100 μg/m³ (annual average concentration).

c) Compared to the WHO guidance value of 40 μg/m³ (annual average concentration) there this has been exceeded in all years since 2008, with the exception of the year 2011.

4.5.3 Statistics and Indicators

In 2012 the monthly mean concentrations of NO_2 varied across the year. Lowest concentrations were observed in Aspire Zone from March to July (range 6.06-8.88 μg/m³) whereas much higher concentrations were observed in August (69.20 μg/m³ monthly average).

Figure 18: Average monthly concentrations of NO_2 (μg/m³) in 2012 per monitoring station

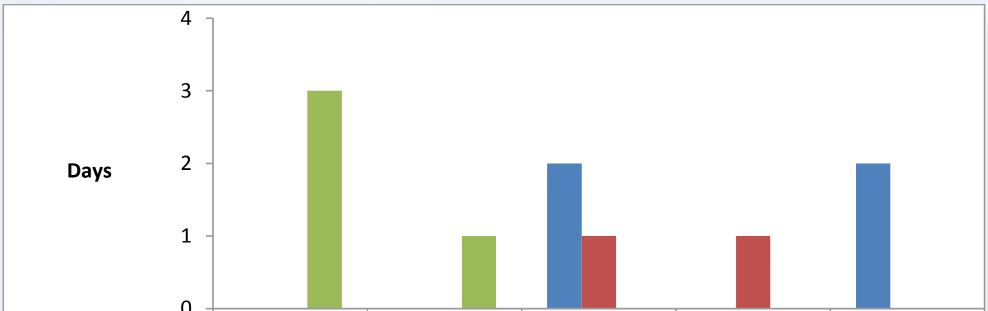


	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Movenpick	50.50	17.43	34.23	47.92	43.43	47.50	44.23	58.27	54.53	44.60	32.87	31.70
Qatar University	34.68	31.31	25.79	37.01	49.25	57.73	30.84	24.16	27.85	19.88	21.02	23.71
Aspire Zone	44.25	47.59	7.90	7.46	6.06	6.30	8.88	69.20	48.56	41.17	69.37	70.92

Data source: MoE

From 2008-2012 on 1-3 days per year the national air quality standards for NO_2 were exceeded. On more than 99% of the days of the year the concentrations of NO_2 were below.

Figure 19: Number of days per year on which the national air quality standards for NO_2 were exceeded per monitoring station



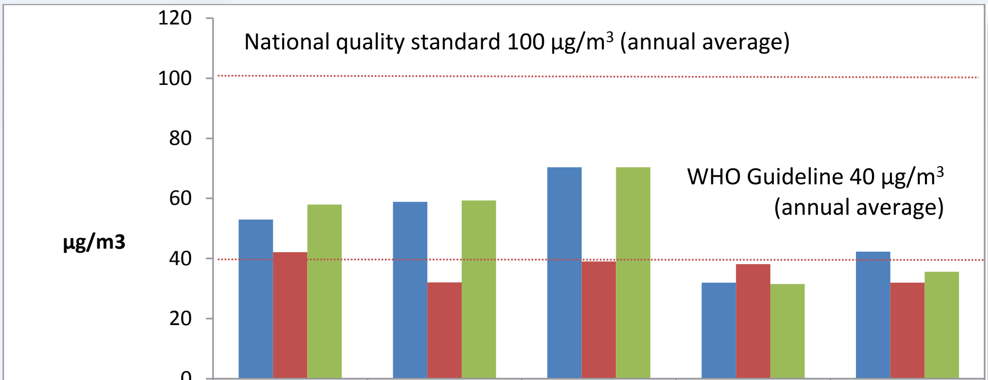
	2008	2009	2010	2011	2012
Movenpick	0	0	2	0	2
Qatar University	0	0	1	1	0
Aspire Zone	3	1	0	0	0

Data source: MoE

The annual average concentrations are below the national quality standard of 100 µg/m³ for all years since 2008 (begin of data availability). In 2008 Aspire Zone had the highest annual average concentrations of all 3 monitoring stations which has decreased from 58.0 µg/m³ in 2007 to 35.6 µg/m³ in 2012.

See Figure 20.

Figure 20: Annual average concentrations of NO_2 in the years 2008-2012 in comparison to the national quality standard (100 µg/m³ annual average concentration) and the WHO guideline (40 µg/m³ annual average concentration)



	2008	2009	2010	2011	2012
Movenpick	53.00	58.90	70.41	31.99	42.27
Qatar University	42.10	32.10	39.06	38.09	31.94
Aspire Zone	58.00	59.30	70.41	31.55	35.64

Data source: MoE

4.6 Carbon monoxide

4.6.1 Rationale

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death (see EPA, 2013).

The national air quality standards (Environmental Protection Law 30/2002) are 40 mg/m³ for the 1 hour average concentration and 10 mg/m³ for the 8 hours average concentration.

4.6.2 Key messages

a) Highest observed concentrations of CO in 2012 were in the summer months (June – September)

b) In 2012 the quality standard of 10 mg/m³ was exceeded for the first time since measurements are available (monitoring station Aspire Zone).

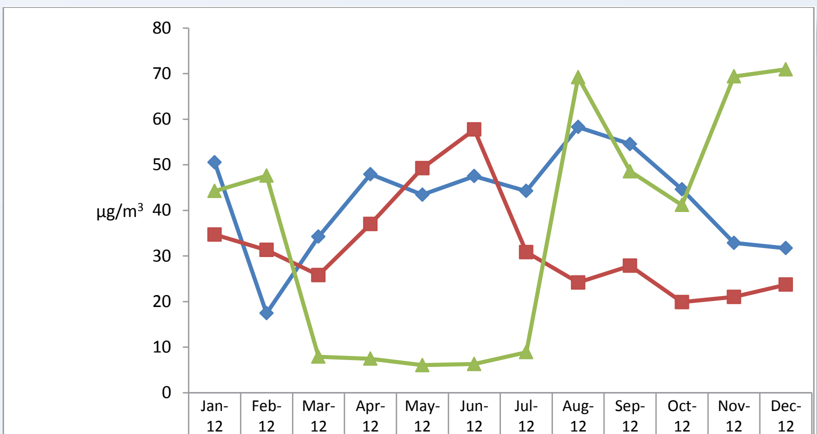
c) Comparing annual average concentrations there is a slight upwards trend.

4.6.3 Statistics and indicators

In 2012 the highest average monthly concentrations of CO were observed from June until September. The concentrations measured at Aspire Zone were mostly higher than those at Movenpick and Qatar University.

The highest 8 hours average concentration was measured in June 2012 at Aspire Zone with 14.51 mg/m³ and thus exceeding the national 8 hours quality standard of 10.00 mg/m³. This was the only exceedance of a quality standard since 2009.

Figure 21: Average monthly concentrations of CO (mg/m³) in 2012 per monitoring station

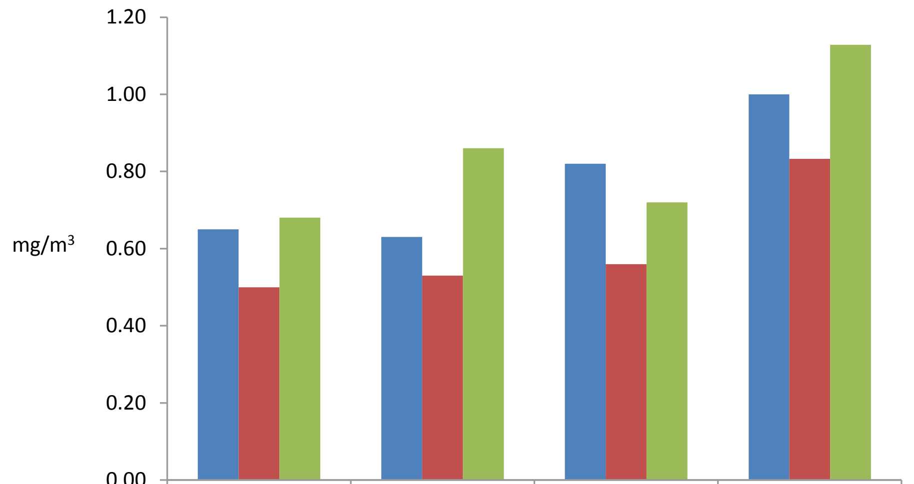


	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Movenpick	50.50	17.43	34.23	47.92	43.43	47.50	44.23	58.27	54.53	44.60	32.87	31.70
Qatar University	34.68	31.31	25.79	37.01	49.25	57.73	30.84	24.16	27.85	19.88	21.02	23.71
Aspire Zone	44.25	47.59	7.90	7.46	6.06	6.30	8.88	69.20	48.56	41.17	69.37	70.92

Data source: MoE

Figure 22 shows the annual average concentrations of CO from 2009-2012 (no data available for 2008). There is a slight upwards trend at all 3 monitoring stations.

Figure 22: Annual average concentrations of CO (mg/m³) from 2009-2012



	2009	2010	2011	2012
Movenpick	0.65	0.63	0.82	1.00
Qatar University	0.50	0.53	0.56	0.83
Aspire Zone	0.68	0.86	0.72	1.13

Data source: MoE

5 Water resources and water uses

Qatar's only natural freshwater resources are precipitation and groundwater. The conservation of the quality and quantity of the country's groundwater resources are one of the targets of the QNDS 2011-2016.

The natural long term water balance (1990 – 2012) of Qatar's groundwater aquifers is as shown in the Table 7. According to this the theoretical maximum exploitable groundwater volume is 47.5 million m³ per year. However the current groundwater abstractions are about 250 million m³ per year, thus causing a depletion of the aquifers with lowering of groundwater levels and increasing of salinity.

Table 7: Natural water balance of Qatar's aquifers (average annual values for period 1990-2012)

No	Balance item	million m^3/year	Data source
1	Recharge of aquifers from precipitation	63.3	MoE (LTAA 1990-2011)
2	Inflow from Saudi Arabia	2.2	DAWR (2006) (LTAA)
3	Total renewable water resources	65.5	Calculation (1+2)
4	Outflow from aquifers to sea and deep saline aquifers	18.0	MoE (LTAA 1990-2011)
5	Average annual water balance*	47.5	Calculation (3-4)

*without the returns from irrigation   Data source: MoE

5.1 Groundwater quality and quantity

5.1.1 Rationale

One of the key concerns of water management in Qatar is the ongoing depletion of its groundwater aquifers. The Qatar National Development Strategy 2011-2016 addresses the need to monitor and to conserve the quality and quantity of freshwater aquifers.

The groundwater depletion can be monitored by changes of groundwater levels and changes of water quality. Overexploitation of groundwater can lead to intrusion of seawater and saline deep groundwater into freshwater aquifers and thus increase the salinity and concentration of dissolved substances. High concentrations of salinity and dissolved substances can make the water unusable for drinking water and agricultural purposes.

Under conventional irrigation practices, water salinity less than 0.7 dS/m usually causes no problems. When the salinity is greater than 3.0 dS/m, serious problems often arise with most crops, which result in reduction of yield or even abandonment of farms (see Water and Agricultural Vision for Qatar by 2020).

In order to present the level of groundwater degradation this chapter includes statistics on groundwater levels, salinity (conductivity) and total dissolved substances (TDS) of the major groundwater aquifers of Qatar.

The groundwater quality results presented below are based on the Groundwater Monitoring Network Programme of the Ministry of Environment, which includes 3,585 samples on 295 wells since April 1998. Some of the monitoring wells contain naturally saline groundwater, because of their location close to the sea or their depth. For the trend assessment of groundwater aquifers therefore the median (50 percentile) was used instead of mean value. With that the influence of single outliers (i.e. extremely high monitoring results at just one well out of many per aquifer) is neglectible.

Data source is the Ministry of Environment.

5.1.2 Key messages

a) Most of the aquifers are moderately saline or moderately – highly saline (according to FAO classification) or show an increasing trend regarding salinity.

b) Groundwater levels in Central Qatar and North Qatar show no significant trend and are slightly above sea level. However, the salinity in Central Qatar shows an increasing trend.

c) The aquifer of Al Mashabiya is moderately – highly saline and significantly below sea level with a further decreasing trend.

d) More monitoring wells would be needed to improve the accuracy of the results.

e) The most recent calculation of the overall groundwater balance shows an annual overexploitation of about 108 million m^3 per year (2012).

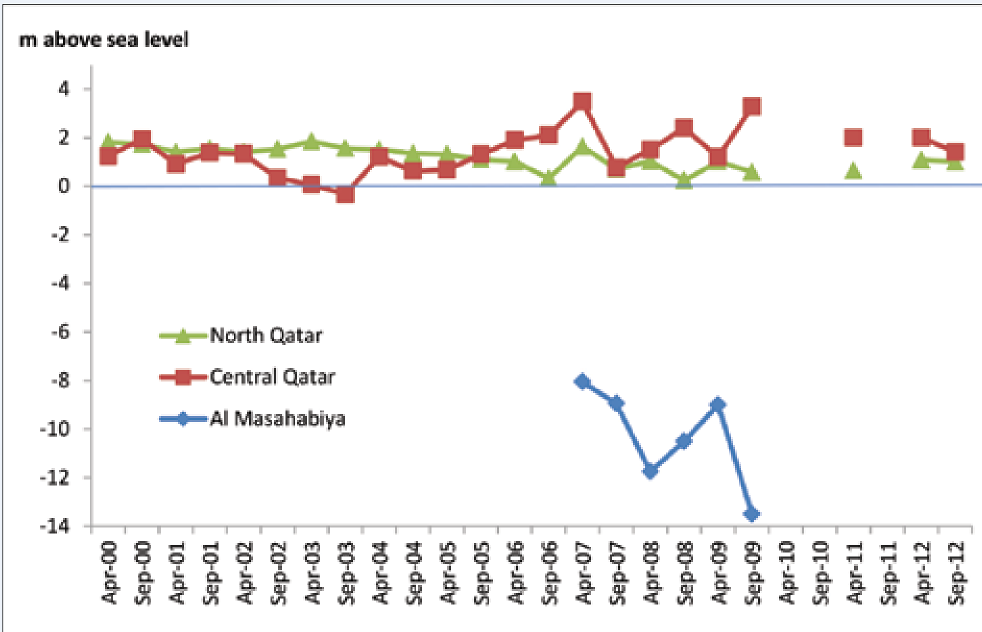
f) 92% of all groundwater abstractions are for agricultural purposes, the remaining 8% are for domestic, municipal and industrial uses.

5.1.3 Statistics and indicators

Reliable time series for the levels of certain groundwater aquifers are available from April 2000 – September 2012. Figure 23 shows the median of the observed levels of groundwater aquifers of North Qatar, Central Qatar and Al Masahabiya. According to this, groundwater levels in North Qatar show a decreasing trend and were only 1 m above sea level in 2012 (median). The groundwater levels in Central Qatar are volatile over time but show no significant long-term trend (median).

In the short observation period for Al Masahabiya a trend downwards can be seen. The median of the observed water levels was already 13.5 m below sea level in Al Masahabiza area in September 2009.

Figure 23: levels of groundwater aquifers in North Qatar, Central Qatar and Al Masahabiya (median of all available observations)



Data source: MoE, calculations done by MDPS

Table 8 as well as Figure 24 and Figure 25 present the trend (median) of salinity, measured as conductivity (dS/m) and total dissolved solids (TDS in ppm) for the 4 aquifers Al Masahabiya, South Qatar, Central Qatar and North Qatar.

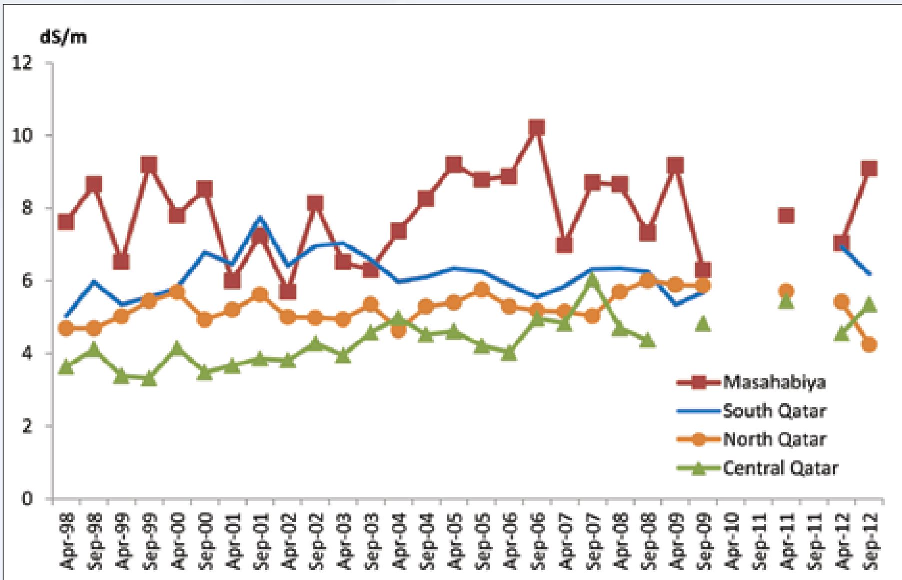
It can be seen that across the entire period from 1998-2012 all 4 aquifers are moderately saline and are increasing in salinity (conductivity). According to the available data TDS is slightly decreasing in Al Masahabiya, North Qatar and South Qatar.

Table 8: Salinity in aquifers monitored from 1998 – 2012: Minimum and maximum median values (median of all wells per aquifer and observation period) and trend

Aquifer	Conductivity (dS/m)		TDS (ppm)		FAO Class	Salinity trend (1998 – 2012)
	Min	Max	Min	Max		
Al Masahabiya	5.70	10.22	3,780	7,368	Moderately – highly saline	No trend
North Qatar	4.25	6.01	2,550	3,840	Moderately saline	No trend
Central Qatar	3.32	6.04	1,920	3,620	Moderately saline	increasing
South Qatar	5.03	7.75	3,205	5,280	Moderately saline	No trend

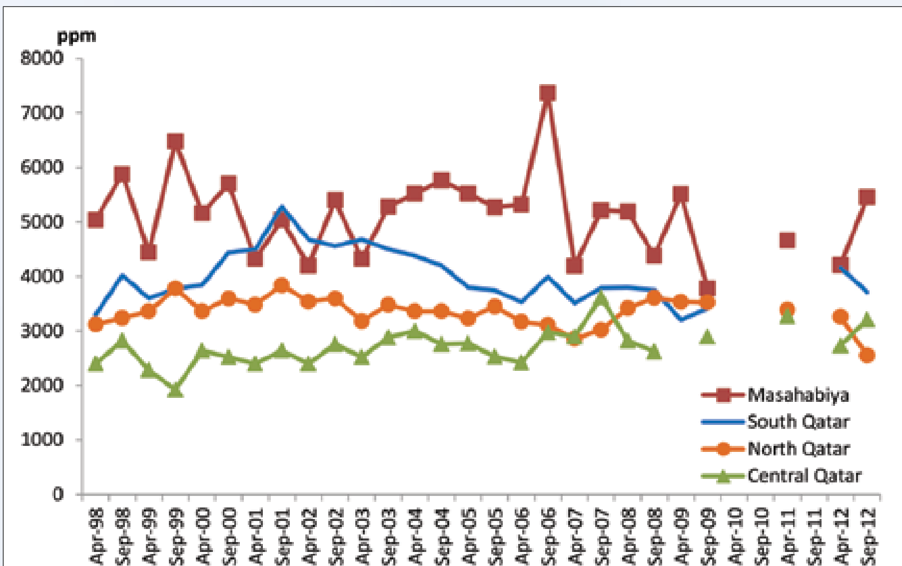
Data source: MoE, calculations done by MDPS

Figure 24: Trend of conductivity in selected aquifers (median)



Data source: MoE, calculations done by MDPS

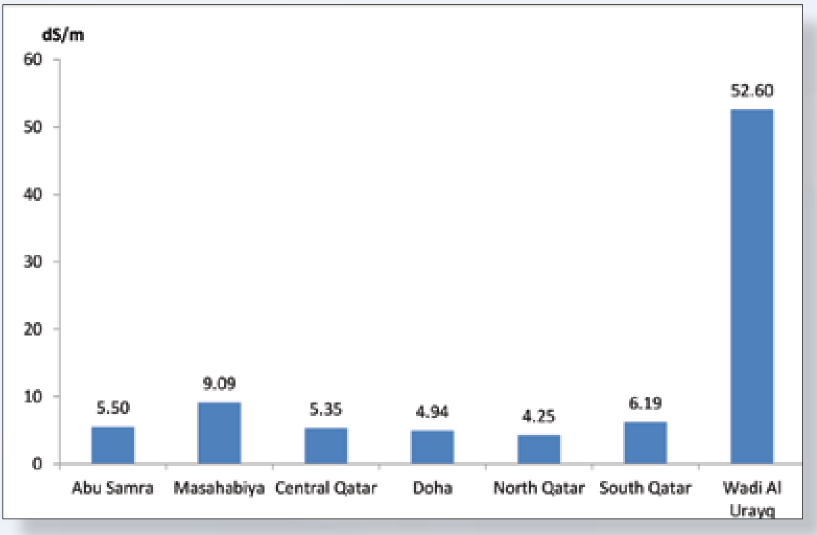
Figure 25: Trend of total dissolved solids (TDS) in selected aquifers (median)



Data source: MoE, calculations done by MDPS

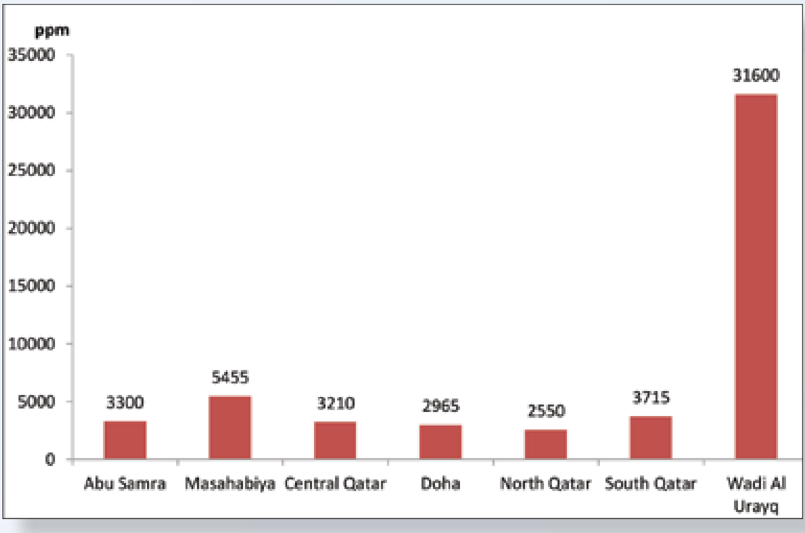
The aquifers with the highest observed salinity (median of conductivity and TDS) in 2012 are Wadi Al Urayq, Masahabiya and South Qatar (see Figure 26 and Figure 27).

Figure 26: Conductivity in September 2012 (median of all wells per aquifer), values for Doha and Wadi Al Urayq from April 2012



Data source: MoE, calculations done by MDPS

Figure 27: Total dissolved solids in September 2012 (median of all wells per aquifer), values for Doha and Wadi Al Urayq from April 2012



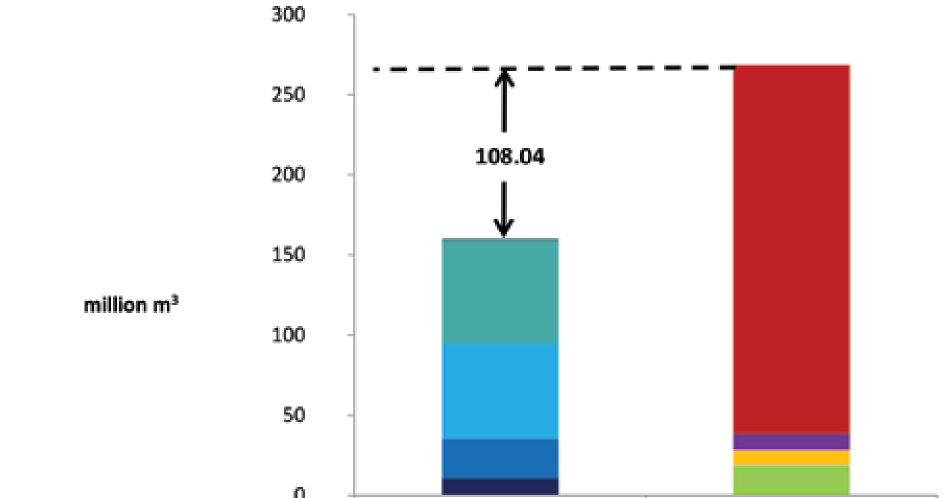
Data source: MoE, calculations done by MDPS

Figure 28 shows the most recent average annual groundwater balance (long-term annual average figures for natural water balance items and 2012 figures for artificial balance items). The long-term natural renewable water resources are about 65.5 million m^3/year (63.3 million m^3 from recharge from precipitation and 2.2 million m^3/year inflow from Saudi Arabia). These natural recharges represent 40% of the annual additions to groundwater stocks. 60% of the annual additions to the groundwater stocks are from artificial recharges (recharge wells), injection of TSE and irrigation returns.

Groundwater abstractions are dominated by abstraction from agriculture with 230 million m^3 in the year 2012 (92% of all groundwater abstractions). Other abstractions from groundwater are for domestic uses (about 10 million m^3/year), municipal uses (about 10 million m^3/year), industrial uses (0.2 million m^3/year) and abstractions by Kahramaa (0.2 million m^3/year).

The difference between increases in groundwater stocks (160.41 million m^3/year) and decreases in groundwater stocks (268.45 million m^3/year) is 108.04 million m^3.

Figure 28: Groundwater balance (LTAA = Long-Term Annual Average)



	Increases in stocks	Decreases in Stocks
Inflow from Saudi Arabia (LTAA)	2.20	
Natural recharge (LTAA)	63.27	
Recharge from irrigation (2012)	59.50	
TSE injection (2012)	24.84	
Recharge wells (LTAA)	10.60	
Agricultural abstraction (2012)		230.05
Industrial abstractions (2012)		0.18
Domestic abstractions (2012)		9.60
Municipal abstractions (2012)		10.38
Abstraction Kahramaa (2012)		0.24
Outflow to sea (LTAA)		18.00

Data sources: MoE, Kahramaa, Ashghal, compilation done by MDPS

5.2 Water abstraction and water use

5.2.1 Rationale

Qatar's population growth and economic growth results in an increasing water demand. In the past this was compensated by increased water desalination capacities and groundwater abstraction.

The current abstraction rates of groundwater are more than 5 times higher than the natural water surplus originating from rainfall and inflow from Saudi Arabia[5]. Abstraction of fresh groundwater is mainly for agricultural purposes to ensure food security.

However, from the water demand side sustainable water use and the protection of the natural groundwater resources (see QNDS) can only be achieved by an increased use of alternative water sources (e.g. Treated Sewage Effluent – TSE), better water use efficiency and the reduction of water losses. The national "Tarsheed" campaign has become an important awareness raising activity to reduce the per capita water and electricity use.

5.2.2 Key messages

a) Main data providers for statistics on water abstraction and water uses are Kahramaa, Ashghal, the Ministry of Environment and the Ministry of Energy and Industry (i.e. Qatar Petroleum's HSE Regulation and Enforcement Directorate and its SDIR programme). These institutions use different reporting frameworks, classifications, terms and definitions and make it difficult to obtain a comprehensive, consistent and coherent set of statistics regarding water abstraction and water uses in the State of Qatar.

b) Water available for use consists of desalinated sea water, treated sewage effluent (TSE) and groundwater abstraction. In 2011 the total volume of water potentially available for use was 771.13 million m^3 of which 53.6% originated from desalination of sea water, 32.4% from groundwater abstraction and 14.0% from generation of TSE.

c) In 2011 more than 10% of the water potentially available for use was not used. It was lost in transport (4.27%), discharged to wastewater lagoons (2.36%), discharged to the sea (0.03%) and injected into aquifers (3.4%).

d) Since 2008 the total groundwater abstractions remain at a level of about 250 million m^3 per year, which is more than 5 times the theoretical maximum sustainable abstraction.

[5] Minus natural outflows to sea and deep saline aquifers.

e) 92% of the groundwater abstractions are for agricultural purposes, whereas 8% were for domestic, municipal and industrial purposes. See also chapter 5.1

f) In 2012 67% of the TSE was directly re-used for irrigation in agriculture and green spaces. 12% were discharged to lagoons and to the sea, thus were not available for further uses. 21% of the TSE was injected into aquifers to compensate of overexploitation.

5.2.3 Statistics and Indicators

The following data sources were used for statistics on water abstraction and water uses:

i. Kahramaa: Detailed MS Excel template for time series 1990-2011 (water production, water losses, net water supply to customers)

ii. Kahramaa: Statistics Report 2012

iii. Ashghal: Detailed MS Excel template for time series 2000-2012 (TSE generation and uses)

iv. Ministry of Environment: Study of 2009: Studying & Developing the Natural & Artificial Recharge of the Groundwater Aquifer in the State of Qatar (groundwater abstraction in 2008 and long-term averages for different purposes)

v. Ministry of Environment: Expert assessment of groundwater abstractions for the years 2009 – 2012.

vi. Ministry of Energy and Industry: Qatar Energy & Industry Sector – Sustainability Report 2012

Assumptions and clarifications regarding the presented statistics:

a) Industrial water uses: Data is available from QP HSEs SDIR programme (published by Ministry of Energy and Industry in 2013) under which 30 companies reported (not full coverage, but 91% of the invited companies). It is assumed that this includes the water uses reported also by Kahramaa as supplied to industries and that the remaining water originates from desalination within the industrial cities.

b) Governmental water uses include watering of green spaces with TSE.

c) Commercial water uses include bulk water supply of Kahramaa to large industrial complexes.

d) Data about unbilled uses were not made available. However, they were calculated by QSA as follows: water production minus losses minus billed uses. The resulting unbilled uses were considered as uses by private households.

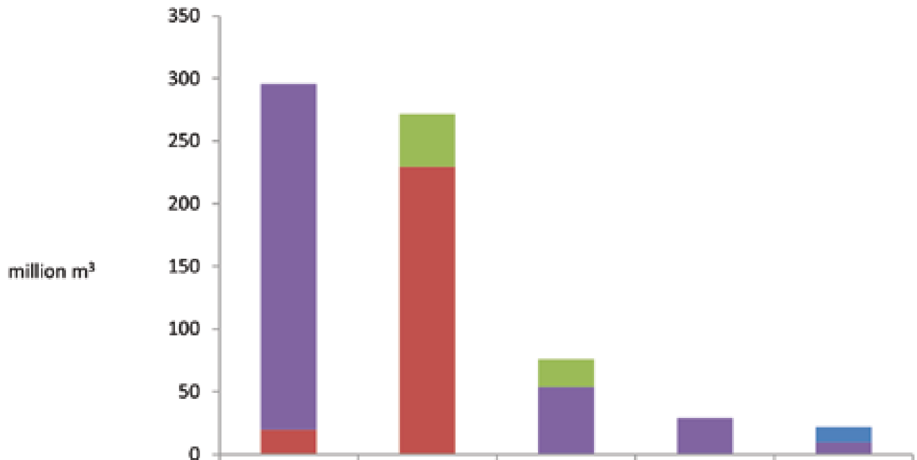
e) Due to lack of detailed 2012 Kahramaa data the latest year for which statistics on sectorial water uses and water losses can be presented is the year 2011.

In 2011 the total water use in the State of Qatar (excluding 32.9 million m^3 losses from the public water supply network) was 693.5 million m^3. The largest water users where private households with 295.6 million m^3, followed by agriculture with 271.4 million m^3 and Government with 75.7 million m^3. Commercial activities used 29.1 million m^3 and Industries 21.7 million m^3.

For agriculture the main sources of water were groundwater (229.5 million m^3 = 85%) and TSE (42.0 million m^3 = 15%).

See Figure 29.

Figure 29: Water use from different sources per sector, after losses in transport (year 2011)



	Private Households	Agriculture	Goverment	Commercial	Industries
TSE	0.0	42.0	21.6	0.0	0.0
Seawater (desalination)	0.0	0.0	0.0	0.0	12.2
Public supply (desalination)	275.7	0.0	54.1	29.1	9.4
Groundwater abstraction	19.9	229.5	0.0	0.0	0.2

Data source: MoE, compiled by MDPS

Table 9 presents the full water use balance of Qatar for the year 2011. It shows that still a significant percentage of the potentially usable water is not used, such as TSE discharged to lagoons and the sea (2.39%) or losses in transport of potable water (4.27%). Injection of TSE into groundwater (3.4%) is one of the measures to fight against groundwater exploitation.

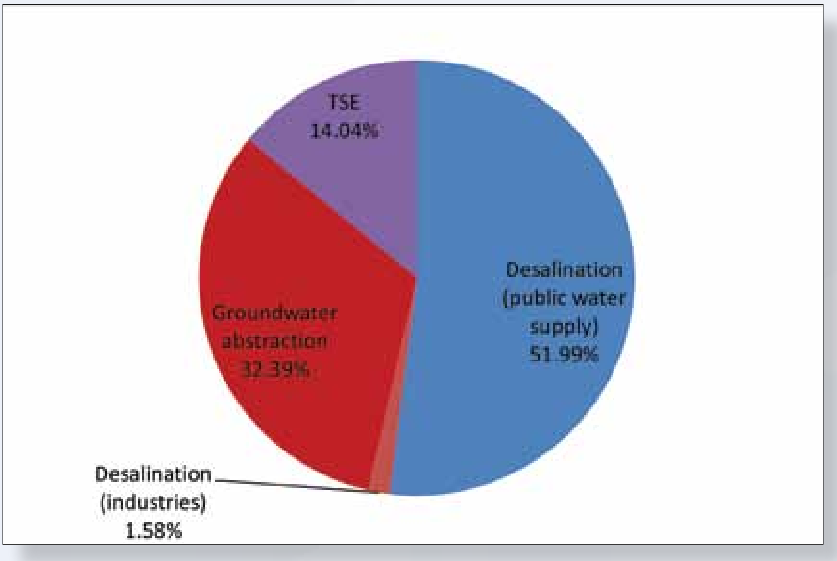
See also Figure 30 and Figure 31.

Table 9: Water use balance 2011

Water use balance 2011 (million m^3)	Water potentially available for use	Water uses and losses	% of total	Remarks
Total desalination (public and industrial)	413.10		53.57%	Public and industrial desalination
Groundwater abstraction	249.77		32.39%	
TSE	108.26		14.04%	
Total water potentially available for use	**771.13**		**100.00%**	
Losses during transport		32.90	4.27%	
TSE discharged to lagoons		18.23	2.36%	
TSE discharged to sea		0.27	0.03%	
TSE injected into aquifers		26.21	3.40%	
Water used by agriculture		271.45	35.20%	Wells and TSE
Water used by industries		21.74	2.82%	Including industrial cities (data from SDIR report)
Water used by commercial activities		29.10	3.77%	Including public water supply to big industrial complexes and hotels
Water used by private households		295.56	38.33%	
Water used by government		75.68	9.81%	Public water supply and TSE for irrigation of greenspaces
Total water uses and losses		**771.13**	**100.00%**	

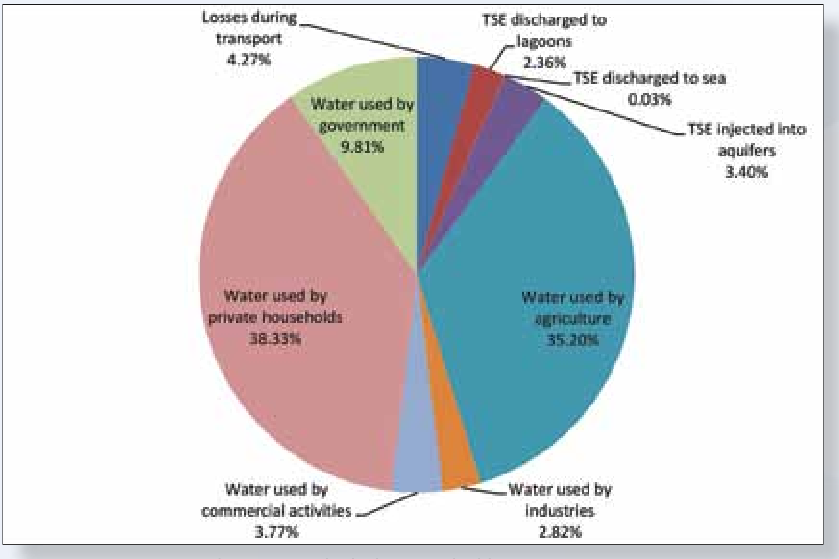
Data sources: MoE, Kahramaa, Ashghal, compiled by MDPS

Figure 30: Water potentially available for use in 2011



Data sources: MoE, Kahramaa, Ashghal, compiled by MDPS

Figure 31: Water uses and water losses in 2011

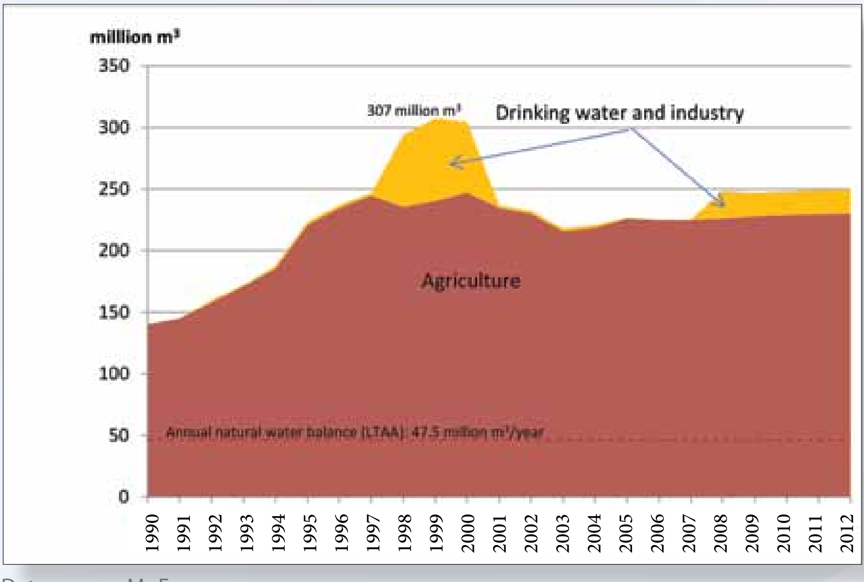


Data sources: MoE, Kahramaa, Ashghal, compiled by MDPS

Figure 32 presents the abstractions from groundwater from 1990-2000. The peak was achieved in the year 1999 with 307 million m^3, which is more than 6 times the natural water balance (LTAA)[6]. Since the year 2008 the annual water abstractions remain at the level of about 250 million m^3, still 5 times the natural water balance (LTAA).

Across all the years agriculture was the dominating purpose for groundwater abstraction (92% in 2012).

Figure 32: Groundwater abstraction from 1990-2012

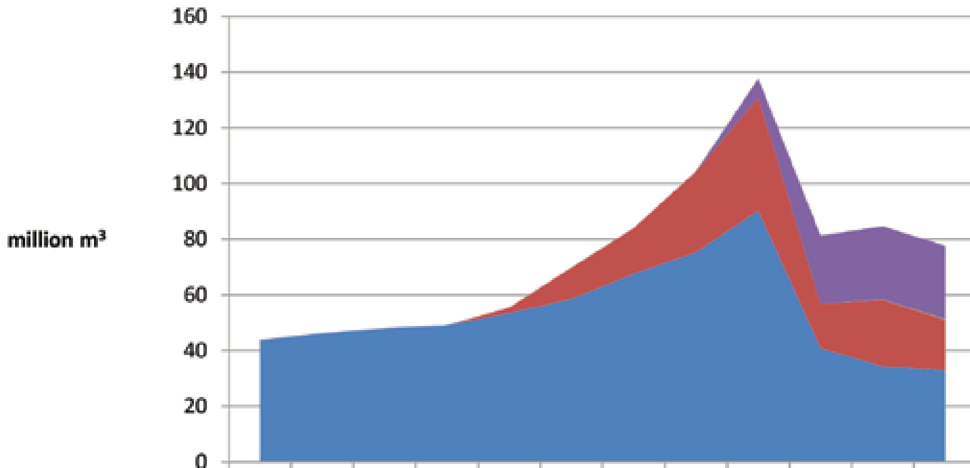


Data source: MoE

Figure 33 presents the development of water losses and unused TSE from 2000 – 2011. It shows that a peak was reached in the year 2008 and that since 2009 both the losses from public water supply networks and TSE discharged to lagoons is significantly decreasing. TSE discharges to sea are marginal and TSE injection into aquifers has become an important measure to compensate for groundwater depletion since 2008. However, for this graph TSE injection is considered as a loss as it could be a source of water to substitute groundwater abstraction by agriculture (provided the available infrastructure is available).

[6] Natural recharge to aquifers plus inflow from Saudi Arabia minus outflow to sea and deep aquifers: 47.5 million m^3 per year (LTAA, see also chapter 5.1).

Figure 33: Unused water and TSE injection (2000 – 2011)



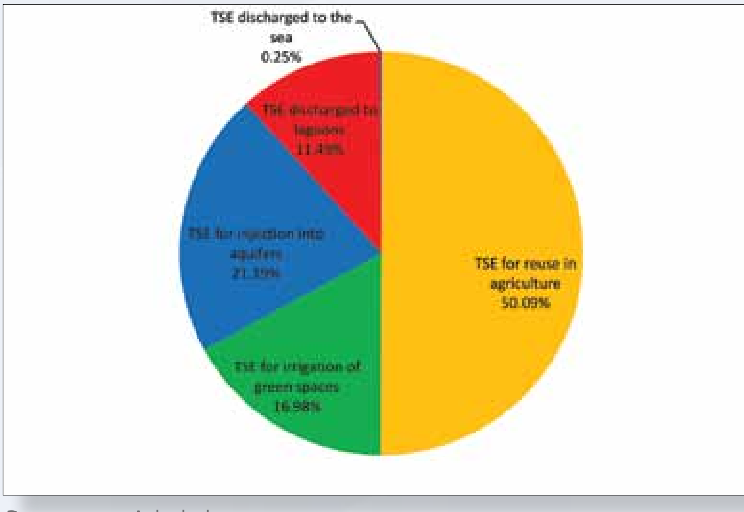
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TSE injected into aquifers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.77	24.48	26.24	26.21
TSE discharged to sea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.27
TSE discharged to lagoon	0.00	0.00	0.00	0.00	1.93	11.21	16.44	28.94	40.62	15.91	23.88	18.23
Losses (public supply)	43.88	46.25	48.12	49.14	53.48	58.59	67.54	75.37	90.27	40.92	34.37	32.90

Data sources: Ashghal, Kahramaa, compiled by MDPS

With the expansion of the capacities for wastewater treatment since 2004 the production of treated sewage effluent (TSE) has increased about 4 times from 24.54 million m^3 (2004) to 117.21 million m^3 (2012). Agriculture has become the most important user of TSE (50% in 2012), followed by the government (for irrigation of greenspaces – 17%). In 2012 11% of the treated wastewater were discharged to lagoons and thus lost for further uses. 21% were injected into aquifers to compensate for over-exploitation of the groundwater resources. Less than 1% of the TSE were discharged to the sea.

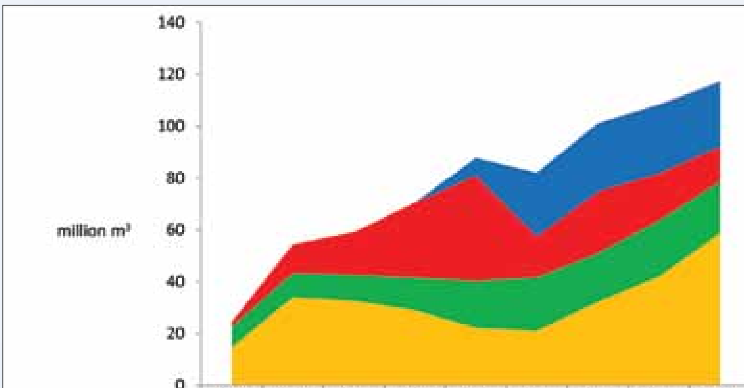
See Figure 34 and Figure 35.

Figure 34: Use and discharge of treated sewage effluent (TSE) in 2012



Data source: Ashghal

Figure 34: Use and discharge of treated sewage effluent (TSE) in 2012



	2004	2005	2006	2007	2008	2009	2010	2011	2012
Discharge to sea	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.27	0.29
Injection into aquifers	0.00	0.00	0.00	0.00	6.77	24.48	26.24	26.21	24.84
Discharge to lagoons	1.93	11.21	16.44	28.94	40.62	15.91	23.88	18.23	13.47
Irrigation of greenspaces	7.85	9.22	9.99	12.53	18.17	20.57	18.63	21.58	19.90
Agriculture	14.77	34.03	32.69	29.05	22.15	21.09	32.28	41.98	58.71

Data source: Ashghal

6 Urban wastewater

The following sections provide statistics about the collection of urban wastewater and the available treatment infrastructure (section 6.1) and the actual treatment as well as quality and quantity of the discharged wastewater (section 6.2).

Statistics about the use of treated sewage effluent (TSE) can be found in section 5.2.

6.1 Urban Wastewater collection and treatment infrastructure

6.1.1 Rationale

In Qatar wastewater collection and treatment infrastructure is important not only to protect the environment from adverse impacts of wastewater pollution but also to provide treated sewage effluent which achieves a quality to be re-used in agriculture, irrigation of green spaces, re-charge of aquifers or other kind of uses.

Furthermore, this infrastructure is essential to provide appropriate sanitation services for all individuals throughout the state (also one of the Millennium Development Goals).

With one of the world's lowest level of rainfall and going towards integrated water resources management, treated wastewater (treated sewage effluent – TSE) is an important alternative to desalination of seawater and abstraction of Qatar's limited fresh groundwater resources. Use of TSE is an important measure to achieve more sustainable water use (see also Qatar National Development Strategy).

Data on urban wastewater treatment in Qatar has been provided by Ashghal, statistics on connected buildings was taken from the 2004 and 2010 Censuses and statistics about safe sanitation is taken from Qatar Statistics Authority and Diplomatic Institute (2012).

6.1.2 Key messages

a) The treatment capacities for urban wastewater treatment increased by 524% from 2004 until 2012. The currently existing urban wastewater treatment infrastructure can treat up to 337,000 m^3/day.

b) Since 2004 all urban wastewater treatment plants are equipped with at least secondary treatment, which ensures the removal of organic pollution to a great extent.

c) In 2012 more than 52% of the treatment capacity (the urban wastewater treatment plant Doha West) provided tertiary treatment with removal of nitrogen and phosphorus.

d) From 2004 until 2010 the number of buildings connected to public sewerage increased by 70%.

e) In 2010 76.9% of the completed buildings were connected to public sewerage. However, in the municipalities of Al Shamal and Al Dayyan no building was connected to public sewerage by the time of the last census (April 2010).

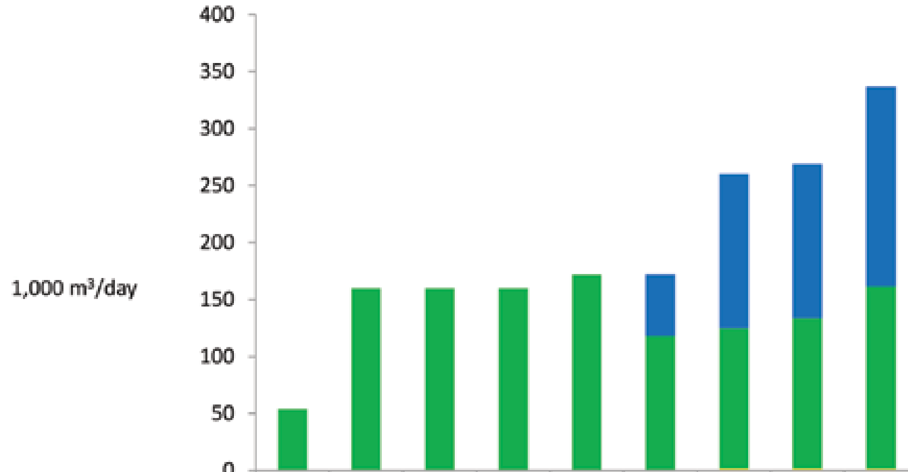
f) Since 2004 safe sanitation is provided to all individuals in the State of Qatar

6.1.3 Statistics and Indicators

Since 2004 the capacity for treatment of urban wastewater increased from 54,000 m^3/day up to 336,900 m^3/day (+524%) in 2012. All existing wastewater treatment plants are equipped with secondary treatment, thus removing organic pollution to a great extent.

In 2009 Doha West was upgraded with nitrogen and phosphorus removal. In 2012 this plant represented 52% of the capacity of all urban wastewater treatment plants in Qatar. See Figure 36.

Figure 36: Hydraulic design capacity per treatment type of urban wastewater treatment plants in Qatar from 2004 - 2012



	2004	2005	2006	2007	2008	2009	2010	2011	2012
Tertiary treatment (N + P removal)						54.0	135.0	135.0	175.5
Tertiary Treatment (Disinfection)	54.0	160.0	160.0	160.0	172.0	118.0	123.0	131.8	159.4
Secondary treatment						0.1	2.2	2.2	2.0

Data source: Ashghal

Table 10 shows the completed urban wastewater treatment plants (UWWTPs) in Qatar with their type of treatment, hydraulic design capacity and wastewater received and treated in 2012. Out of the 18 UWWTPs 4 were equipped with secondary treatment, 13 with tertiary treatment (disinfection) and 1 (Doha West) with additional removal of nitrogen and phosphorus.

Table 10: Urban wastewater treatment plants (UWWTPs) in 2012: type of treatment, hydraulic design capacity and wastewater received

Name of UWWTP	Type of treatment	Design capacity		Wastewater received (1,000 m^3/year)
		(1,000 m^3/day)	(1,000 m^3/year)	
Al Shammal	Secondary	0.15	55	39
Al-Dhakhira PTP	Tertiary (disinfection)	1.60	584	882
Al-Jamiliyah PTP	Secondary	0.54	197	122
Al-Khor PTP	Tertiary (disinfection)	4.86	1,774	1,656
Barwa Al Baraha PTP	Tertiary (disinfection)	12.00	4,380	Not in operation yet
Barwa City STW	Tertiary (disinfection)	15.00	5,475	125
Barwa Msaimeer PTP	Tertiary (disinfection)	1.50	548	268
Barwa Sailiyah PTP	Tertiary (disinfection)	1.50	548	243
Barwa Village PTP	Tertiary (disinfection)	1.00	365	158
Doha South STW	Tertiary (disinfection)	106.00	38,690	55,390
Doha West STW	Tertiary (N and P)	175.50	64,058	66,195
Duhail PTP	Tertiary (disinfection)	0.81	296	145
Industrial Area STW	Tertiary (disinfection)	12.00	4,380	3,545
North Camp PTP	Tertiary (disinfection)	0.25	91	25
Ras Abu Fontas PTP	Secondary	0.54	197	75
Shahaniyah PTP	Tertiary (disinfection)	1.35	493	450
Slaughter House PTP	Secondary	0.81	296	114
Umm Slal PTP	Tertiary (disinfection)	1.50	548	435
Total		**336.91**	**122,972**	**129,867**

Data source: Ashghal

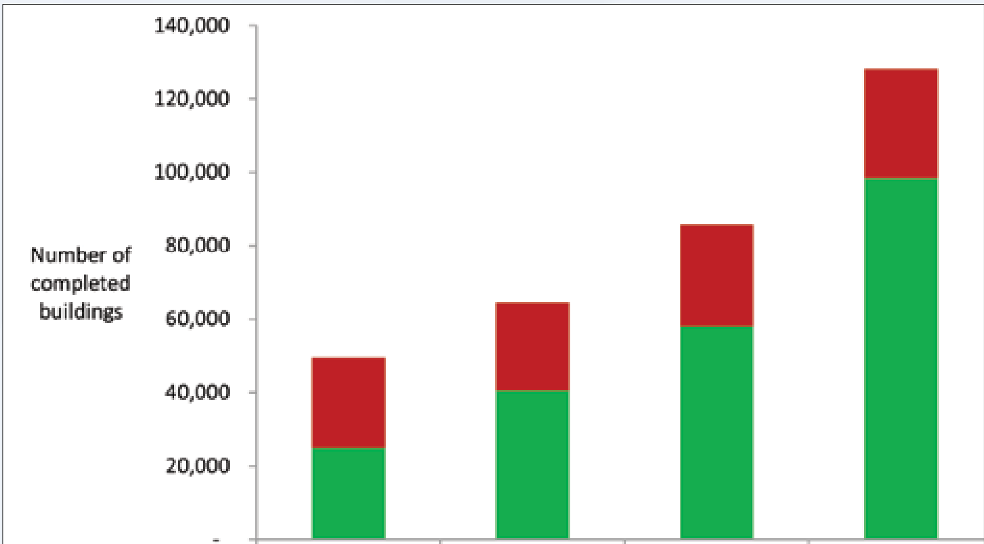
According to statistics from Census (1986 – 2010) the number of completed buildings connected to public sewerage increased from 25,037 (50.5% of the completed buildings) in 1986 to 98,515 (76.9% of the completed buildings) in 2010 (see Figure 37)

Population living not-connected buildings were served by tankers transporting the wastewater to wastewater treatment plants and sewage lagoons.

In 2010 the highest degree of buildings connected to the public sewerage was in Doha (94.1%), whereas the municipalities of Al Shamal and Al Dayyan were not connected at all. See Figure 38.

Since 2004 safe sanitation is provided to all individuals in Qatar (see Qatar Statistics Authority and Diplomatic Institute, 2012).

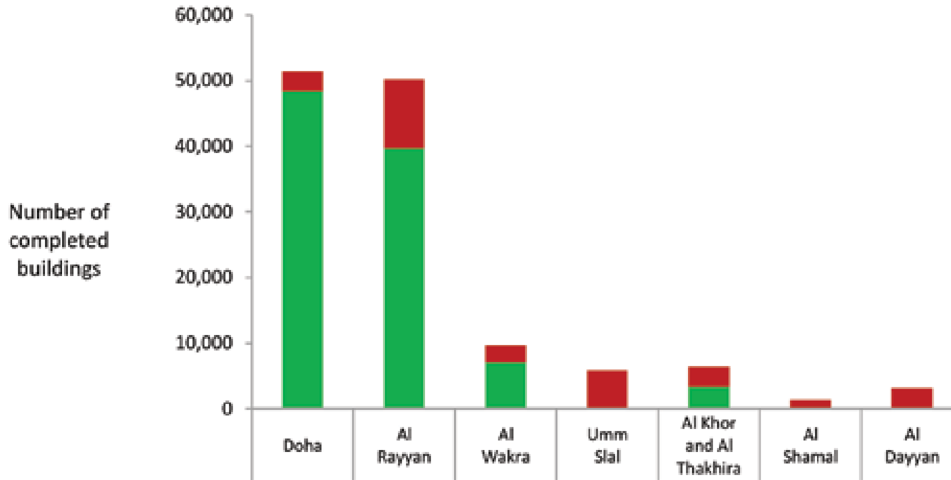
Figure 37: Completed buildings connected to the public sewerage according to Censuses 1986 - 2010



	1986	1997	2004	2010
Not connected to sewer	24,553	23,872	27,853	29,559
Connected to sewer	25,037	40,528	57,952	98,515

Data source: MDPS

Figure 38: Connection to public sewerage in April 2010 (Census 2010) by municipalities



	Doha	Al Rayyan	Al Wakra	Umm Slal	Al Khor and Al Thakhira	Al Shamal	Al Dayyan
Not connected to sewer	3,044	10,505	2,614	5,769	3,119	1,357	3,151
Connected to sewer	48,369	39,693	7,066	41	3,346	0	0

Data source: MDPS

6.2 Urban wastewater treatment, wastewater discharges and qualities

6.2.1 Rationale

Reduction of the adverse impacts from pollution by wastewater is important to not only conserve Qatar's groundwater resources (see QNDS 2011-2016), but also to protect coastal waters and land ecosystems from eutrophication and other unwanted impacts. Untreated wastewater can also have an impact on human health when discharged on land closely to settlements or discharged to sea closely to bathing waters

Use of treated sewage effluent (TSE) is an important measure to achieve more sustainable water use (see also Qatar National Development Strategy) and to reduce groundwater abstraction and the use of desalinated water for irrigation purposes in agriculture and for green spaces. For statistics about TSE use and discharge see chapter 5.2.3.

Data about wastewater volumes discharged and organic pollution (in terms of Biological Oxygen Demand - BOD_5 and Chemical Oxygen Demand - COD) exist for all wastewater treatment plants whereas data about emissions of total nitrogen and total phosphorus are only available for Doha West. All data were provided by Ashghal.

6.2.2 Key messages

a) In 2012 the total generation of wastewater (excluding industrial cities) was 151.65 million m^3. 86% of it was treated in wastewater treatment plants.

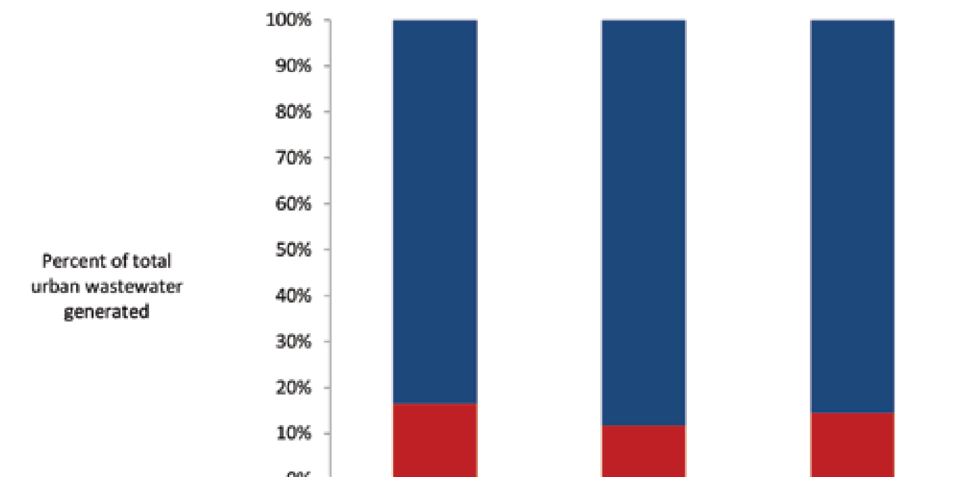
b) Since 2004 removal of organic pollution (BOD_5 and COD) is at a level of more than 95% most of the time. In 2012 99.2% of the BOD_5 load and 96.7% of the COD load were removed by the 18 urban wastewater treatment plants.

c) Qatar's largest urban wastewater treatment plant, Doha West, achieves high removal rates for BOD_5, COD, total nitrogen and phosphorus. In 2012 more than 66 million m^3 wastewater (43.6% of the total urban wastewater generated in Qatar) were treated in Doha West and 99.5% of BOD_5, 96.6% of COD, 86.7% of total nitrogen and 85.4% of total phosphorus were removed.

6.2.3 Statistics and indicators

Since 2010 more than 83% of the urban wastewater is treated in urban wastewater treatment plants (UWWTPs). In 2012 86% of the wastewater was treated. The not treated wastewater is collected by tankers and discharged to Al-Karaana Lagoon (21.90 million m^3 in the year 2012). See Figure 39.

Figure 39: Percentage of generated wastewater treated in wastewater treatment plants (2010-2012)



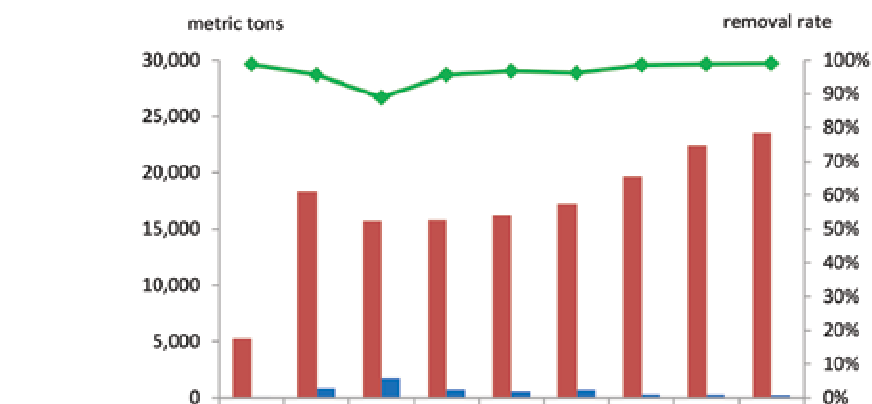
	2010	2011	2012
Urban wastewater treated in UWWTPs (mio. m3)	101.65	123.35	129.75
Untreated urban wastewater to lagoon (mio. m3)	20.08	16.43	21.90

Data source: Ashghal

Organic pollution (in terms of BOD_5) has been removed by more than 95% in most of the years since 2004. From 2004 to 20102 the load of collected BOD_5 has increased from 5,217 metric tons to 23,509 metric tons (+351%) whereas in the same period the discharges only increased from 64 metric tons to 224 metric tons (+252%). See Figure 40.

From 2004 – 2012 also COD was removed to a high degree (more than 90% in most of the years). The COD load sent for wastewater treatment increased from 14,911 metric tons to 54,695 metric tons (+267%) whereas in the same period the discharges only increased from 1,148 metric tons to 2,174 metric tons (+89%).

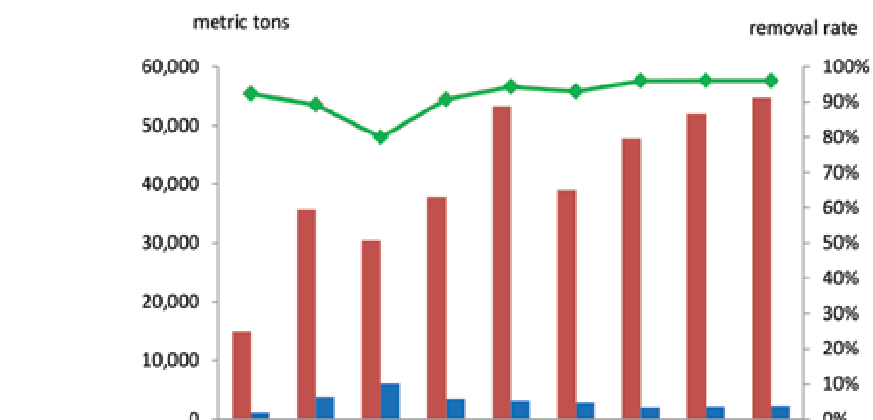
Figure 40: Treated and discharged BOD_5 loads from 2004 – 2012



	2004	2005	2006	2007	2008	2009	2010	2011	2012
BOD incoming load	5,217	18,285	15,680	15,776	16,225	17,237	19,672	22,360	23,509
BOD discharged load	64	795	1,746	692	524	661	280	267	224
Removal rate	98.8%	95.7%	88.9%	95.6%	96.8%	96.2%	98.6%	98.8%	99.0%

Data source: Ashghal, calculated by MDPS

Figure 41: Treated and discharged COD loads from 2004 - 2012

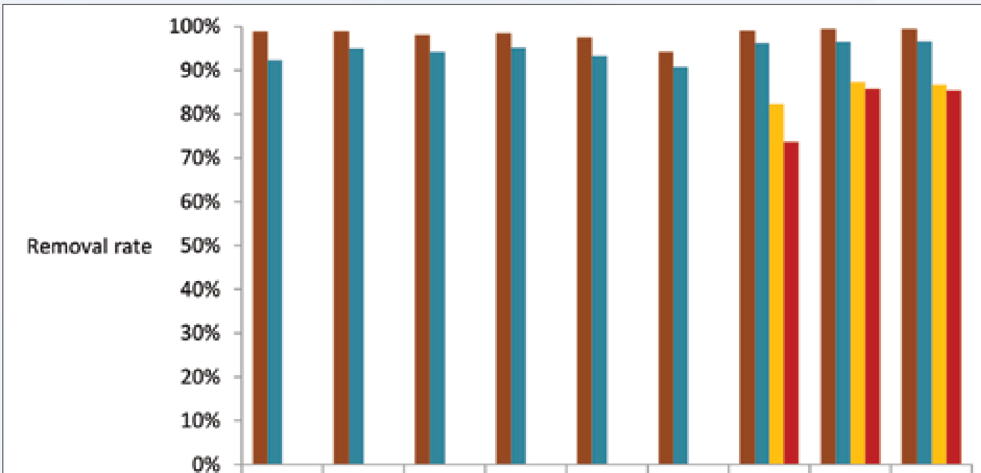


	2004	2005	2006	2007	2008	2009	2010	2011	2012
COD incoming load	14,911	35,580	30,399	37,791	53,259	38,994	47,739	51,924	54,695
COD discharged load	1,148	3,849	6,100	3,514	3,041	2,759	1,917	2,046	2,174
Removal rate	92.3%	89.2%	79.9%	90.7%	94.3%	92.9%	96.0%	96.1%	96.0%

Data source: Ashghal, calculated by MDPS

Qatar's largest UWWTP, Doha West (treatment capacity 175,500 m^3/day), is equipped with nitrogen and phosphorus removal since 2009. Since 2010 nitrogen removal rates are above 82% and the removal rate of phosphorus has increased to more than 85% since 2011. See Figure 42.

Figure 42: Removal rates of BOD_5 , COD, total nitrogen and total phosphorus at UWWTP Doha West



	2004	2005	2006	2007	2008	2009	2010	2011	2012
BOD5	98.78%	98.81%	97.97%	98.44%	97.50%	94.17%	99.03%	99.45%	99.48%
COD	92.30%	94.96%	94.19%	95.14%	93.16%	90.73%	96.24%	96.48%	96.58%
Nitrogen							82.35%	87.33%	86.74%
Phosphorus							73.60%	85.71%	85.37%

Data source: Ashghal, calculated by MDPS

7 Air Emissions

7.1 Greenhouse Gas Emissions

7.1.1 Rationale

Qatar's economy is based on the production of oil and gas (44% of GDP in 2012). Qatar is one of the leading countries for hydrocarbon extraction which results in a variety of emissions of greenhouse gases (GHGs) due to flaring and diffuse emissions.

In a ranking of the World Bank Qatar is considered to be the country with the highest per capita greenhouse gas emissions (44.0 tons in 2009). This indicator does not say much about environmental behavior in Qatar as it is dominated by GHGs of the Oil and Gas sector which is divided by a relative small number of resident population.

Qatar has organized the international climate conference COP 18 in 2012 and used this opportunity to re-emphasize its commitment towards reduction of GHG emissions.

On the hydrocarbon production side there is potential to reduce greenhouse gas emissions by technological solutions (e.g. reduction of emissions from flaring) and on the user side by increased use of alternative energies, change of behavior and increased energy efficiency. Statistics show that there are first success stories such as better flaring performance and reduced GHG intensity of the overall economy.

The QNDS target related to the reduction of GHG emissions addresses gas flaring. The gas flaring intensity should be reduced to 0.0115 billion cubic meters per million tonnes of energy produced from the 2008 level of 0.0230 billion cubic meters per million tonnes of energy produced.

Currently there is no regularly updated GHG emissions inventory available, but Qatar as a non-Annex I country of the United Nations Framework Convention on Climate Change (UNFCCC, ratified by Qatar on 18 April 1996) has submitted an Initial National Communication to the UNFCCC in 2011 (MoE, 2011). This initial communication includes the only official GHG Inventory for the State of Qatar reference year 2007). Official time series about total greenhouse gas emissions from national sources were not available for this report, therefore for time series external data sources (World Bank and Carbon Dioxide Information Analysis Center) were used to show trends.

Industrial emissions (which are the majority of national GHG emissions) are monitored and documented by Qatar Petroleum's SDIR programme.

7.1.2 Key messages

a) A regularly updated GHG emissions register does not exist. Thus, data has to be taken from different national and international sources. Therefore, at the time being data are not fully coherent and discrepancies between the different data sources have to be accepted.

b) In the year 2010 Qatar contributed to 0.21% of the global GHG emissions

c) In 2010 the GHG emissions of Qatar were more than 5 times higher than in the year 1990 (from 11,775 thousand tons in 1990 to 70,531 thousand tons in 2010) and still show an increasing trend.

d) Qatar's GHG emissions are coupled with economic growth and population growth. However, the emission intensity is decreasing significantly since the mid 1990ies. The emission intensity per GDP has decreased from a maximum of 646.7 metric tons per million Qatari Rial GDP in 1993 to 248.2 tons per million Qatari Rial GDP in 2010. The peak of GHG emissions per capita was in 1997 with 67.6 metric tons per capita and has decreased to 41.1 metric tons per capita in 2010.

e) 50% of the total GHG emissions (2007) originated from the oil and gas sector.

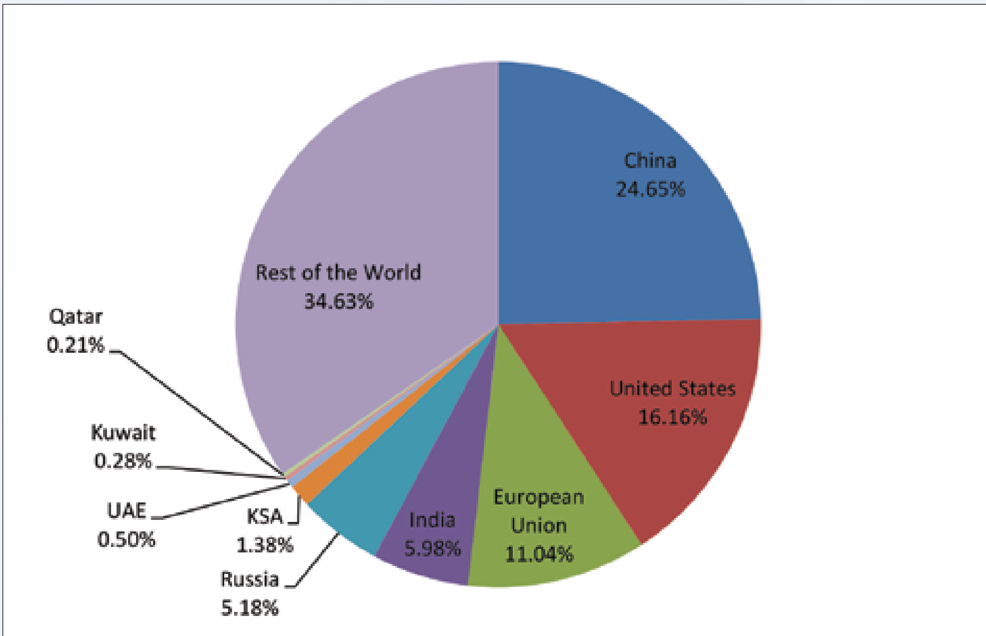
f) Flaring was reduced by 9.9% from 2011 until 2012 among comparable industries. The largest reductions are observed in refining (-43%) whereas the other subsectors showed increasing flaring quantities.

g) The flaring intensity (in terms of flared gas per produced energy) was reduced by more than 50% from 2008-2010.

7.1.3 Statistics and Indicators

In 2010 Qatar's GHG emissions of 70,531 thousand tons were 0.21% of the total global GHG emissions (according to World Bank). The largest emitters were China (24.65% of total GHG emissions) and the United States of America (16.16% of total GHG emissions).

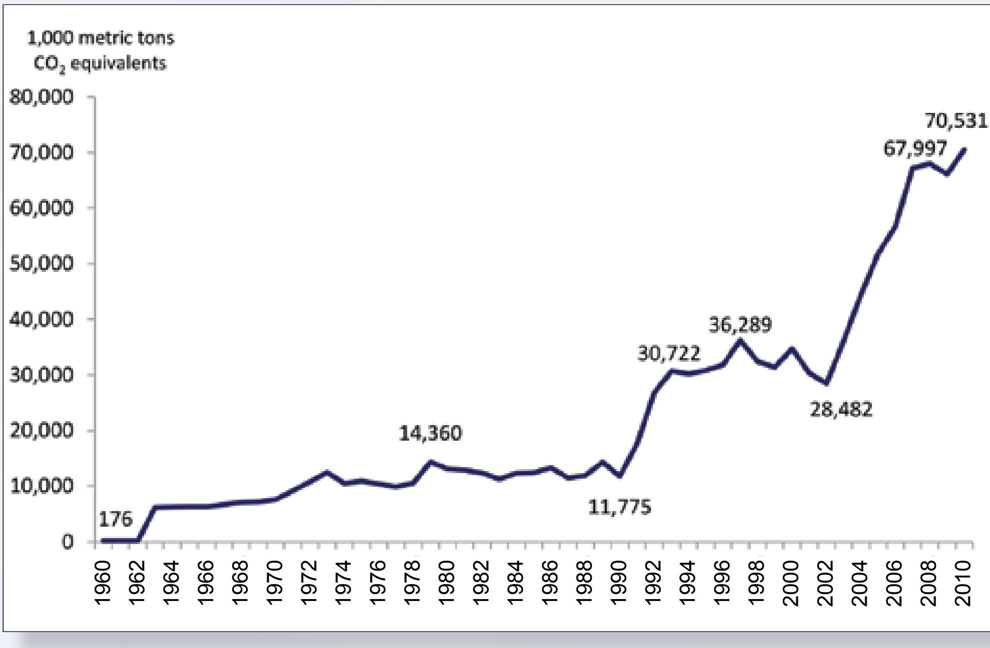
Figure 43: Proportion of Qatar's contribution to the global emissions of GHG (year 2010, according to World Bank)



Data source: World Bank

Figure 44 presents the development of GHG emissions (in thousand tons CO_2 equivalents since 1960. According to World Bank Data the total GHG emissions increased from 176 thousand metric tons in 1960 up to 70,531 thousand metric tons CO_2 equivalents in the year 2010.

Figure 44: Total GHG emissions (CO_2 equivalents) of Qatar 1960 – 2010 according to World Bank

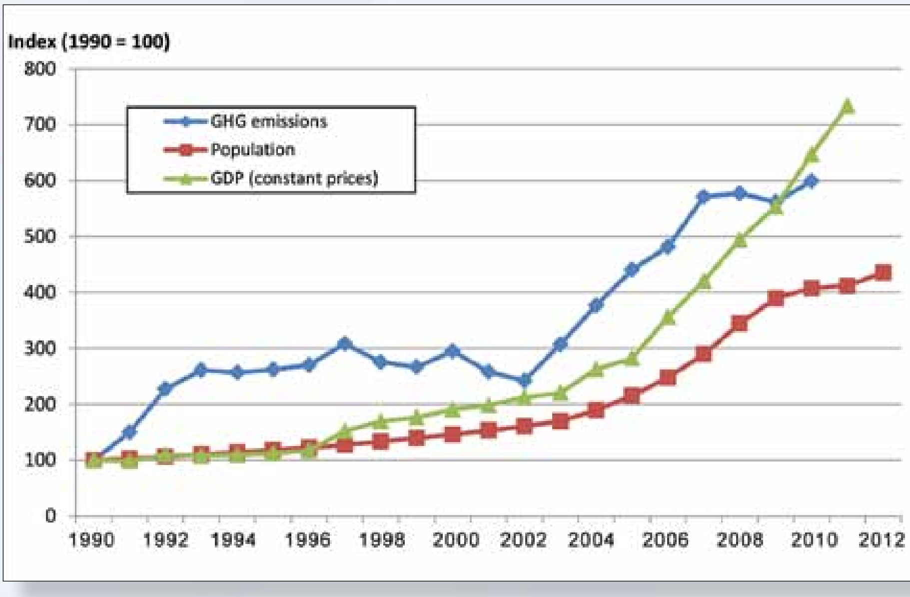


Data source: World Bank

Figure 45 compares the trend of GHG emissions with economic growth (GDP) and population growth in form of an index (base year 1990). It can be seen that there is no decoupling of GHG emissions from economic growth and population growth. However, the figure also shows a higher growth rate of GDP than GHG emissions since 2006.

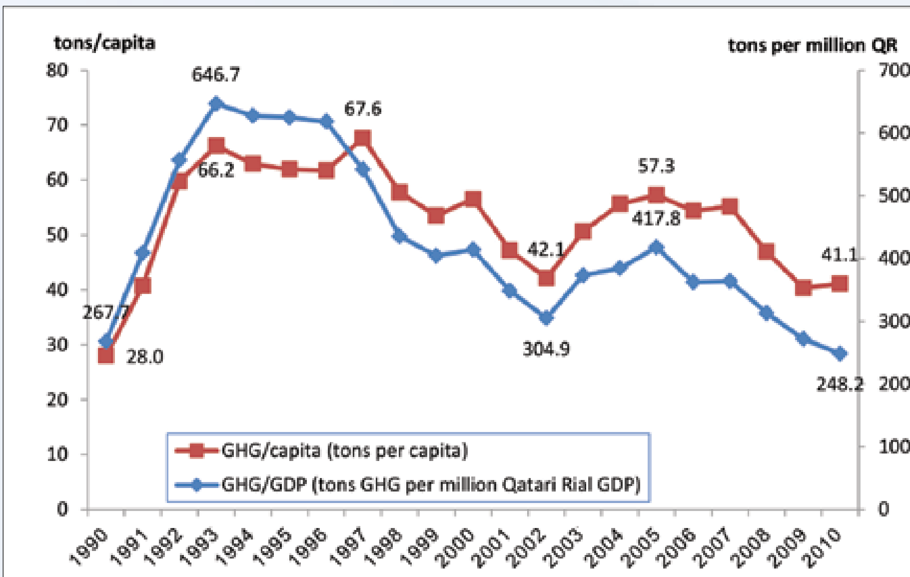
Figure 46 shows the GHG emission intensity in terms of GHG emissions per capita and GHG emissions per GDP. The emission intensity per GDP has decreased from a maximum of 646.7 metric tons per million Qatari Rial GDP in 1993 to 248.2 tons per million Qatari Rial GDP in 2010. The same trend can be observed in terms of GHG emissions per capita: The peak was in 1997 with 67.6 metric tons per capita and has decreased to 41.1 metric tons per capita in 2010.

Figure 45: Comparison of trend of GHG emissions with growth of GDP (constant prices) and population



Data sources: World Bank and MDPS, compiled and calculated by MDPS

Figure 46: GHG emission intensities 1990 - 2010



Data sources: World Bank and MDPS, compiled and calculated by MDPS

Regarding the sectorial contribution to the total air emissions the most comprehensive data available can be found in Qatar's Initial Communication to the UNFCCC (reference year 2007). This inventory does not only include the most relevant GHG CO_2, CH_4 and N_2O, but also shows the sectorial contribution to other air emissions (NO_x, CO, NMVOCs and SO_2). See Table 11.

Table 11: Air Emission Inventory (2007) of Qatar's Initial National Communication to the UNFCCC

Air Emission Source Categories (1,000 metric tons)	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Total Air emissions	**57,615**	**164**	**1.3**	**175**	**43**	**133**	**144**
Total Energy	**52,924**	**137**	**1**	**162**	**43**	**104**	**127**
Fuel combustion activities	46,507	68	1	158	24	66	73
Energy industries	38,124	66	1	75	22	12	67
Manufacturing industries and Construction	3,106	1	0	39	1	6	6
Transport	5,277	1	0	44	1	48	0
Fugitive Emissions from Fuels	6,417	69	0.22	4	19	38	54
Solid Fuels	0	0	0	0	0	0	0
Oil and Natural Gas	6,417	69	0.22	4	19	38	54
Total Industrial Processes	**4,687**	**7.49**	**0.11**	**14**	**0**	**0.83**	**16.79**
Mineral Products (i.e. Cement Production)	798	0.36	0.0072	6.12	0	0.14	5.41
Chemical Industry	3,831	6.91	0.1	7.03	0	0.63	10.38
Metal Production	58	0.22	0.004	0.39	0	0.06	1
Total Solvent and Other Product Use	**0**	**0**	**0**	**0**	**0**	**28**	**0**
Total Agriculture	**4.04**	**0**	**0**	**0**	**0**	**0**	**0**

Table continued on next page

Air Emission Source Categories (1,000 metric tons)	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Enteric Fermentation	3.84	0	0	0	0	0	0
Manure Management	0.2	0	0	0	0	0	0
Waste management	**0.14**	**19.69**	**0**	**0**	**0**	**0**	**0**
Solid waste disposal on land	0	16	0	0	0	0	0
Wastewater handling	0	3.69	0	0	0	0	0
Waste incineration	0.14	0	0	0	0	0	0

Data source: MoE (2011)

According to the emissions inventory of Qatar's Initial Communication to UNFCCC (MoE, 2011) can be calculated to be 62,116 thousand metric tons (gigagrams). This differs from the World Bank Calculations for the same year (67,997 thousand metric tons – see Figure 44), but is in the same order of magnitude.

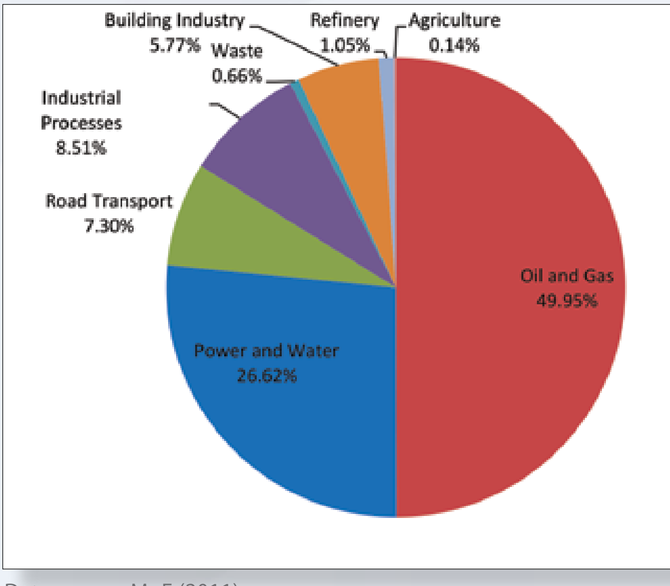
Table 12: Calculation of total GHG emissions in CO_2 equivalents based on Qatar's Initial National Communication to the UNFCCC (year 2007)

Total GHG Emissions	CO_2	CH_4	N_2O	Total
1,000 metric tons	57,615.18	164.18	1.33	
Conversion factor (IPCC 4th Assessment Report)	1.00	25.00	298.00	
Total (1,000 metric tons CO_2 equivalents)	**57,615.18**	**4,104.50**	**396.70**	**62,116.38**

Data source: MoE (2011), calculated by MDPS

Figure 47 shows that about 50% of the total GHG emissions in 2007 were from the oil and gas industry (MoE, 2011).

Figure 47: Major contributors to Qatar's National GHG emissions in 2007



Data source: MoE (2011)

Gas flaring decreased from 2011 to 2012 by 10% according to the Sustainability Report 2012 of the Ministry of Energy and Industry (based on the data of 14 comparable companies). Flaring performance varies across subsectors, petrochemicals increased by 98% among four comparable companies and refining decreasing flaring by 43% from two comparable companies. See Table 13.

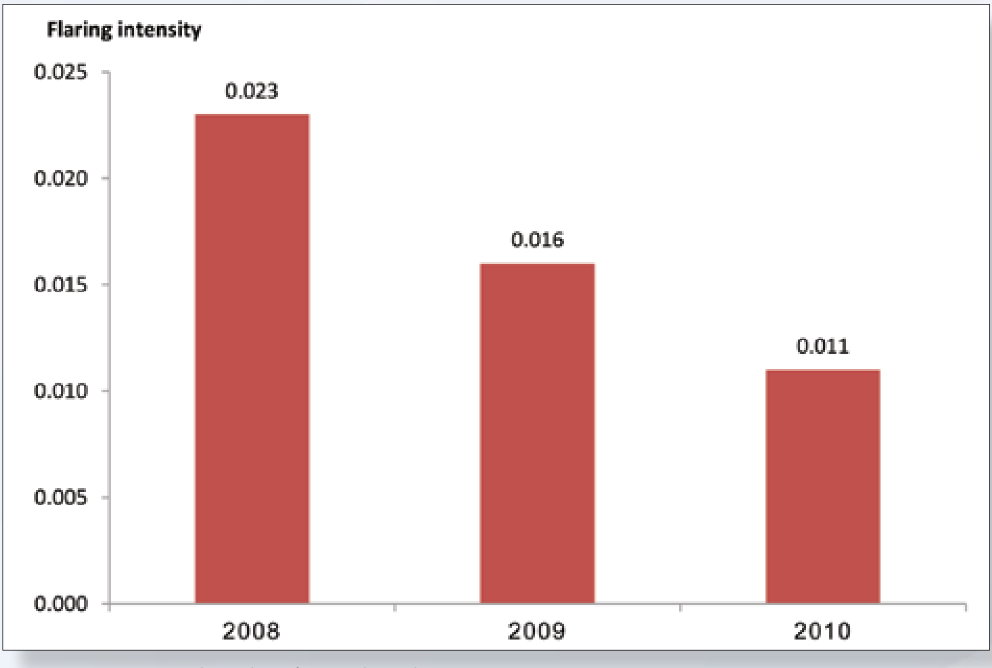
Table 13: Flaring by subsector

Subsector	Companies Reporting		Flaring (MMSCM)			% change for comparable companies
	2011	2012	2011	2012	2012 for comparable companies	
LNG/NG	3	3	1,910	2,071	2,071	+8%
Refining	2	2	2,102	1,202	1,202	-43%
Oil and gas	5	5	596	668	668	+12%
Petrochemicals	4	5	195	558	385	+98%
Total	**14**	**15**	**4,803**	**4,499**	**4,326**	**-10%**

Data source: MoE (2011)

Figure 48 presents the flaring intensity in terms of billion cubic metres flared gas per million tonne of energy production. According to this statistics (see GSDP, 2012 and MoEI, 2013) the flaring intensity was reduced by more than 50% from 2008 – 2010.

Figure 48: Flaring intensity 2008-2010 (bcm / million tonnes for energy production)



Data sources: GSDP (2012) and MoEI (2013)

7.2 Consumption of Ozone Depleting Substances

7.2.1 Rationale

Ozone Depleting Substances (ODS) are substances with content of chlorine or bromine, which if released into atmosphere, have potential of destroying the stratospheric ozone layer that absorbs most of dangerous ultraviolet radiation. Phasing out ODS is an ongoing process, taking into account efforts in creating substitute materials with zero ODP and low GWP characteristics, able to satisfy both the Ozone Depleting Potential (ODP) and global warming potential (GWP) requirements.

The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer are dedicated to the protection of the earth's ozone layer. With 197 parties, they are the most widely ratified treaties in United Nations history, and have, to date, enabled reductions of over 97% of all global consumption of controlled ozone depleting substances (measured in ODP tones). Also the Millennium Development Goals call for a reduction of ODS according to the Montreal Protocol.

Ozone Depletion Potential (ODP) tons is an indicator used to monitor the reduction of Ozone Depleting Substances. ODP tons are metric tons of substance weighted by the amount of ozone depletion caused by this substance. It is directly related to the impact of a similar mass of CFC-11. The important CFC replacement HCFC-22 has and ODP of 0.055 and HFC-134a has an ODP of zero (but a global warming potential of 1,300 CO_2-equivalents). See also Table 14.

Global Warming Potential (GWP) represents another aspect of effect of chemicals emitted into air which can have to be taken into account as air emission indicator. GWP is a given mass of a chemical contributing to global warming within a time period (20, 100 or 500 years) against the same mass of CO_2 whose GWP is defined as 1.0. As it is explained environmental significance of GWP expands through many years ahead (UNFCCC) and thus its decrease should be carefully monitored.

Table 14 shows the ODP and GWP of the most common ozone depleting substances consumed in Qatar (consumed between 2005 and 2012).

Table 14: ODP and GWP of Ozone Depleting Substances consumed in Qatar between 2005 and 2012

Substance	Ozone Depleting Potential (ODP)	Global warming potential (GWP, 100 years)	Typical use
CFC-11	1.000	3800	Propellant and refrigerant, not consumed in Qatar anymore
CFC-12	1.000	8100	Refrigerant and aerosol spray propellant, not consumed in Qatar anymore
HCFC-22	0.055	1500	Refrigerants, solvents, blowing agents for plastic foam manufacture, and fire extinguishers; used as a transitional CFC replacement
HFC-134a	0.000	1300	One of the most widely used refrigerant blends, component of other refrigerants, foam blowing agent, fire suppressant and propellant in metered-dose inhalers and aerosols.

Qatar has ratified the Montreal Protocol on substances that deplete the Ozone Layer (ODS) in 1996 and is therefore committed to face out the consumption of CFCs.

Data source is the Ministry of Environment (data from 2005-2012) and the database of the Montreal Protocol (data from 1995-2004).

7.2.2 Key messages

a) From 1998 until 2007 the consumption of ozone depleting substances in Qatar decreased from 175.3 to 36.6 ODP tons per year (-79%). In the same time period the annual per capita consumption decreased from 0.26 ODP kg to 0.03 ODP kg (-89%). However, from 2007 until 2012 the consumption more than doubled up from 36.6 to 82.4 ODP tons per year and the per capita consumption increased by 50%.

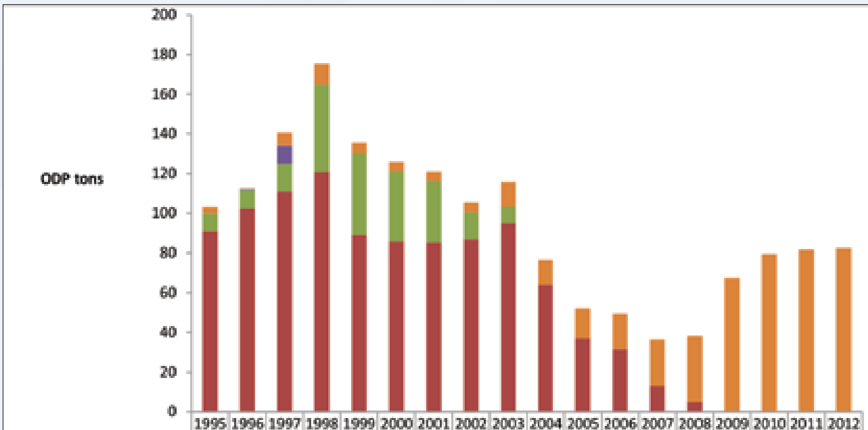
b) In 2012 compared to 2005 the consumption of ODS was 6.16 times higher in terms of mass, 3.66 times higher in terms of global warming potential and 0.58 times higher in terms of ozone depleting potential.

7.2.3 Statistics and Indicators

Figure 49 shows that after the ratification of the Montreal Protocol the consumption of ozone depleting substances (measured in ODP tons) had a significant downwards trend from 1998 (175.3 ODP tons) until 2007 (36.6 ODP tons). From 2007 on an increasing consumption can be observed which is mainly due to the substitute HCFC-22.

The consumption of Halons phased out in 2003 and Chlorofluorocarbons (CFCs) in 2008. From 2009 on Hydrochlorofluorocarbons (HCFCs-22) and HFC-134a were the only Ozone Depleting Substances still consumed in Qatar (which have a low ODP but still a very high GWP).

Figure 49: Consumption of Ozone Depleting Substances in Qatar from 1995 – 2012 (ODP tons)

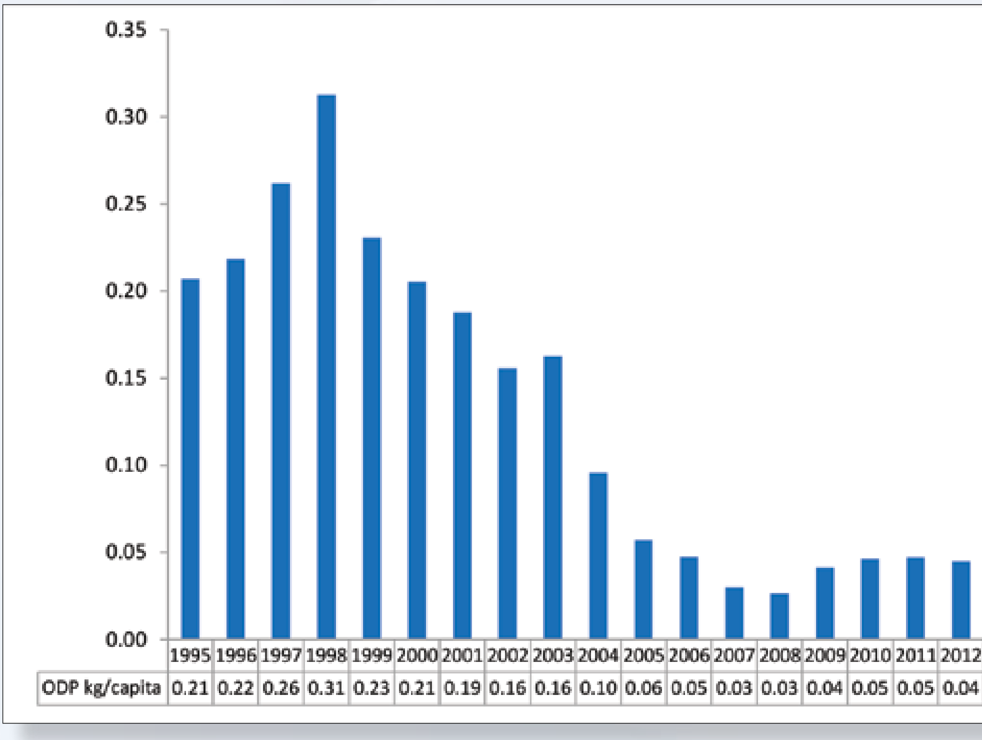


	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
HCFCs	3.2	0.5	6.4	10.6	5.0	5.0	4.8	5.1	12.5	12.7	15.0	17.9	23.5	33.2	67.4	79.5	81.6	82.4
Methyl Chloroform	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carbon Tetrachloride	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Halons	9.0	9.0	14.0	43.9	41.4	35.2	30.7	13.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CFCs	90.9	102.4	111.0	120.8	89.0	85.8	85.4	86.7	95.1	63.7	37.0	31.4	13.0	5.1	0.0	0.0	0.0	0.0

Data sources: MoE and website of the Montreal Protocol, compiled and calculated by MDPS

The per capita consumption of ozone depleting substances (in terms of ODP) has significantly decreased from 1998 until 2012. Figure 50 shows that the peak was reached in 1998 with 0.31 kg/capita and that since 2006 the consumption remains at a level of 0.03-0.05 kg/capita/year.

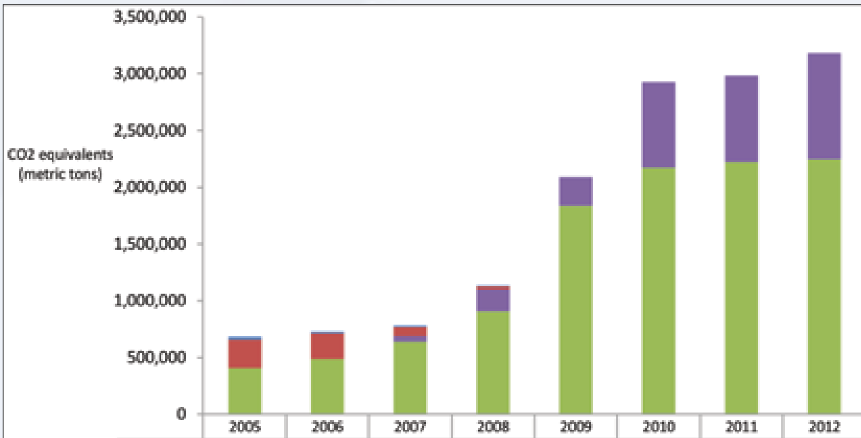
Figure 50: Consumption of Ozone Depleting Substances per capita from 1995 – 2012 (kg/capita)



Data sources: MoE and website of the Montreal Protocol, compiled and calculated by MDPS

Looking at ODPs together, including the substitute HFC-134a (with no ODP, but high GWP) there has been an increase of the global warming potential by 366% between 2005 and 2012 (see Figure 51).

Figure 51: Global warming potential (GWP) of the consumed ozone depleting substances in metric tons of CO_2 equivalents

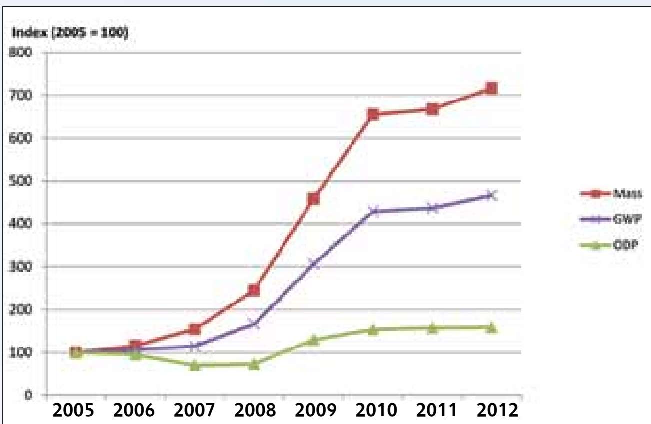


	2005	2006	2007	2008	2009	2010	2011	2012
CFC-11	23,142	16,538	11,522	6,764	0	0	0	0
CFC-12	250,371	219,348	81,000	26,487	0	0	0	0
HFC-134a	0	0	46,072	193,050	249,990	755,040	755,300	933,010
HCFC-22	408,330	488,775	641,670	906,000	1,837,500	2,169,000	2,224,650	2,246,100

Data source: MoE, calculated by MDPS

Figure 52 compares the trend of the consumption of ODS in Qatar (2005-2012) expressed in mass, GWP and ODP. It shows that the consumption in terms of mass has increased by 616%, the global warming potential by 366% and the ozone depleting potential by 58%.

Figure 52: Comparison of the consumption of ozone depleting substances in terms of mass, GWP and ODP



Data source: MoE, calculated by MDPS

8 Biodiversity and biological resources

Qatar's biodiversity is face threats from a range of human activities. This includes population growth and rapid urbanization. Construction and industrialization are impacting fragile coastal habitats and marine life. International shipping and trade have introduced invasive species that threaten indigenous species. Overfishing has emerged as both an ecological concern and a threat to future food supply (see GSDP, 2012).

Biodiversity is not only essential to national identity and culture, it is also providing important ecosystem services such as the provision of fish stocks and recreational services (e.g. marine life for tourism and diving).

8.1 Protected areas

8.1.1 Rationale

The QNDS acknowledges that biodiversity is facing threats from a range of human activities. This includes population growth and rapid urbanization, but also international shipping and over-fishing.

One of the measures to protect biodiversity is to establish actively managed protected areas. The related target of the QNDS is to expand these areas.

Data source is the Ministry of Municipalities and Urban Planning. Data until 2011 were made available.

8.1.2 Key messages

a) In 2011 more than 23% of the land area of Qatar were designated as protected natural areas. In total there are 11 protected environmental areas.

b) Since 2009 two marine protected areas exist, Khor Al-Odaid and Al-Thakhira. Their total area is 721 km^2.

8.1.3 Statistics and Indicators

The total protected area has increased from 58.15 km^2 in 2005 up to 3,463.17 km^2 in 2011. Since 2009 there are also 721 km^2 marine area protected (Al Thakhira and Khor Al Odaid). See Map 4 and Table 15.

Map 4: Protected Natural Areas of Qatar (2011)

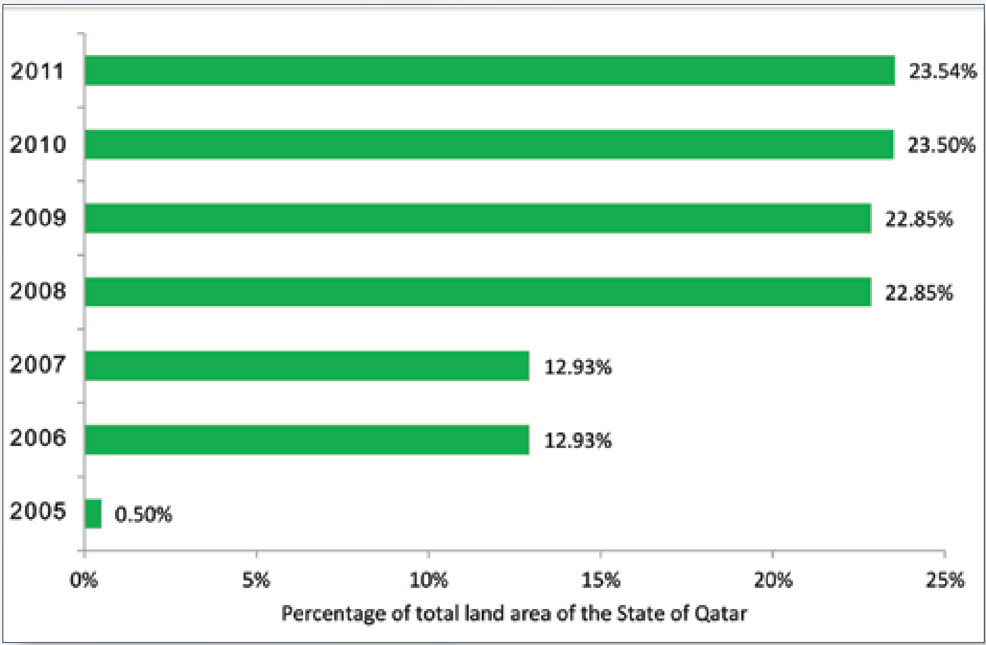
Table 15: Size of protected natural areas (land and marine) from 2005 - 2011

Protected Areas (km²)	2005	2006	2007	2008	2009	2010	2011
Land area	58	1,506	1,506	2,662	2,662	2,738	2,743
Marine area	0	0	0	721	721	721	721
Total area	58	1,506	1,506	3,383	3,383	3,459	3,464

Data source: MoE, General Directorate for Nature Reserves. (Private Engineering Office)

Figure 53 shows the development of protected land areas since 2005. In 2011 23.54% of the total land area of the State of Qatar was protected natural areas.

Figure 53: Percentage of total land area of the State of Qatar designated as protected area



Data source: MoE, General Directorate for Nature Reserves. (Private Engineering Office)

Table 16 lists the protected natural areas (year 2011). The largest is Khor Al-Odaid with a land area of 1,293.20 km^2 (11.10% of the area of Qatar) and a marine area of 540.07 km^2.

Table 16: List of protected areas (2011)

Protected Natural Areas	Land		Marine	Total
	km^2	%	km^2	km^2
Total area of Qatar (with islands)	11,651.25	-	-	-
Al Ureiq	54.76	0.47%	-	54.76
Al Thakhira	113.17	0.97%	180.44	293.61
Khor Al Odaid	1,293.20	11.10%	540.07	1,833.27
Al Rafa	53.33	0.46%	-	53.33
Um Alamad	5.72	0.05%	-	5.72
Um Qarn	24.71	0.21%	-	24.71
Sunai	3.92	0.03%	-	3.92
Al Reem	1,154.10	9.91%	-	1,154.10
Shahaniyah	0.79	0.01%	-	0.79
Al Maszhabiya	4.76	0.04%	-	4.76
Lusail	34.73	0.30%	-	34.73
Total	**2,743.19**	**23.54%**	**720.51**	**3,463.70**

Data source: MoE, General Drectorate for Nature Reserves. (Private Engineering Office)

8.2 Fish catch

8.2.1 Rationale

Statistical data on fishery is an important prerequisite for the adoption of measures to develop a sustainable fishery industry. The Qatar National Development Strategy 2011-2016 addresses the need to monitor overfishing (see Figure 31) which presents both ecological impacts and a threat to food supply.

The United Nations Convention on the Law of the Sea (UNCLOS III) came into force in 1994 and it was ratified by Qatar on 9 Dec 2002[7]. UNCLOS also provides fishing related sustainability indicators (see UNSD, 2013):

[7]UNCLOS,
http://treaties.un.org/pages/ViewDetailsIII.aspx?&src=TREATY&mtdsg_no=XXI~6&chapter=21&Temp=mtdsg3&lang=en

- Yield-related indicators: Catches
- Capacity-related indicators: Fishing effort and fishing intensity

8.2.2 Key messages

a) Since the 1950ies fish catch in terms of mass shows an exponential increase. From 1950 until 1999 total fish exploitation in Qatar is more than tenfold up from 400 to 4,397 metric tons per year. From 2000 until 2008 total fish exploitation also was more than doubled up from 7,140 to 17,688 metric tons per year. Since 2009 the total fish catch shows a decrease from 14,066 (2009) to 11,274 (2012) metric tons per year.

b) 20% of the mass of the fish caught in 2012 are classified as "over-exploited", which means that there is a high risk of stock depletion for that particular species.

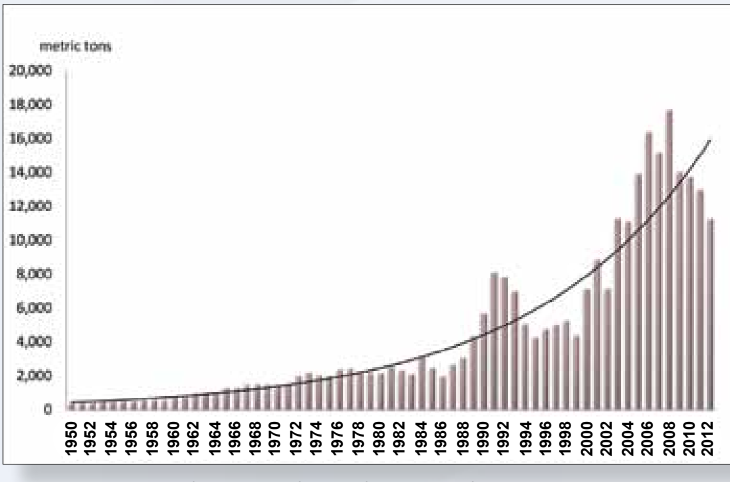
c) The number of fisherman has decreased by 31% since the year 2000, whereas the number of fishing boats remained at the same level (514 in the year 2000, 499 in the year 2012).

d) Both the fish catch per boat and the fish catch per fisherman showed a rising tendency from the year 2000 until 2006. Since 2007 fish catches per boat and per fisherman are decreasing (from 38.8 metric tons/boat in 2006 to 22.6 metric tons/ boat in 2012, from 5.7 metric tons/fisherman in 2006 to 3.2 metric tons/fisherman in 2012.).

8.2.3 Statistics and Indicators

Total fish catch has increased from 400 metric tons per year in 1950 to 11,274 metric tons in 2012. A peak was reached in the year 2008 with 17,688 metric tons of fish caught in Qatar. See Figure 54.

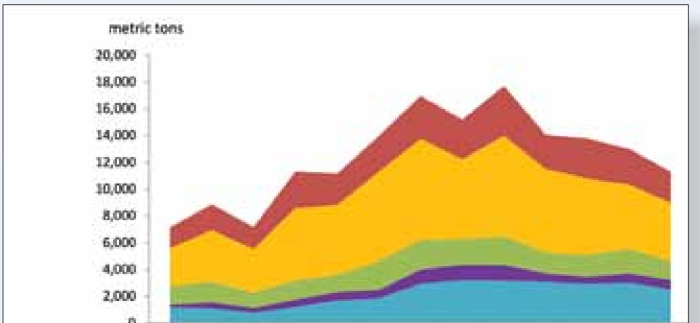
Figure 54: Total fish catch in Qatar (1950 – 2012)



Data sources: MoE (2000-2012), FAO (1950-1999)

Figure 55 shows that fish catches in terms of mass had an increasing trend for all types of fish until 2008 and since then it had a significant downwards trend. However, in 2012 20% of the mass of the fish caught was classified as over-exploited and thus at high risk of stock depletion. This includes fish species such as the Narrow-barred Spanish Mackerel, the Sordid Sweetlip and the Painted Sweetlip.

Figure 55: Fish catches by level of exploitation (2000-2012)

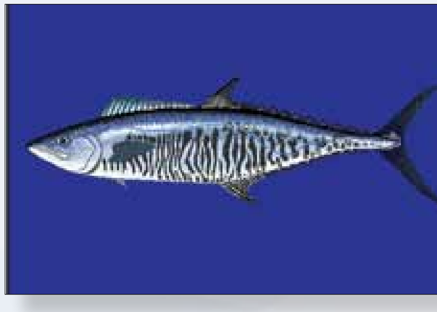


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Over-exploited	1,557	1,919	1,637	2,701	2,316	2,666	3,182	2,952	3,699	2,562	2,982	2,650	2,299
Maximally exploited	2,842	3,845	3,253	5,408	5,245	6,686	7,554	5,988	7,521	6,261	5,697	4,819	4,370
Sustainably exploited	1,379	1,571	1,144	1,438	1,268	2,136	2,236	1,904	2,140	1,541	1,617	1,827	1,395
Under-exploited	199	426	327	560	619	626	1,030	1,157	1,171	631	535	688	685
Not classified	1,163	1,104	795	1,189	1,687	1,845	2,944	3,183	3,158	3,072	2,928	3,010	2,526

Data source: MoE

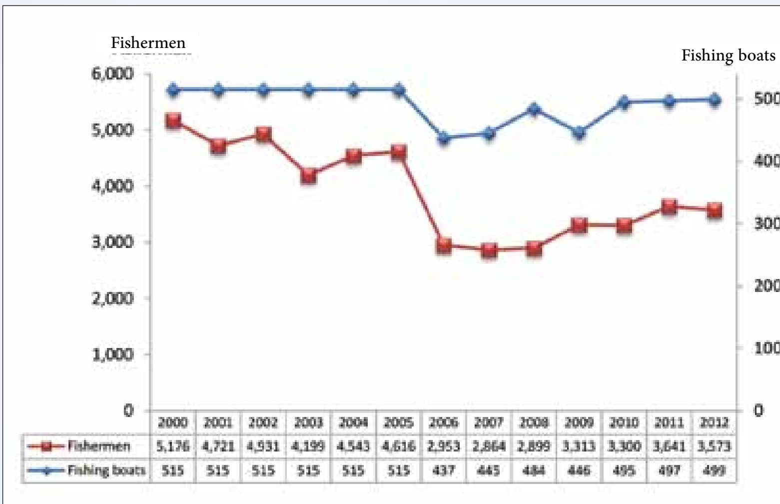
Picture 1: Sordid Sweetlip on a fishmarket in Qatar

Picture 2: Narrow-barred Spanish Mackerel (Source: Wikipedia)



The number of fishing boats has remained at almost the same level from 2000-2012 (499 fishing boats in 2012), whereas the number of fishermen has decreased by 31%. In 2012 3,573 people were working as fishermen in Qatar.

Figure 56: Fishing effort



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fishermen	5,176	4,721	4,931	4,199	4,543	4,616	2,953	2,864	2,899	3,313	3,300	3,641	3,573
Fishing boats	515	515	515	515	515	515	437	445	484	446	495	497	499

Data source: MoE

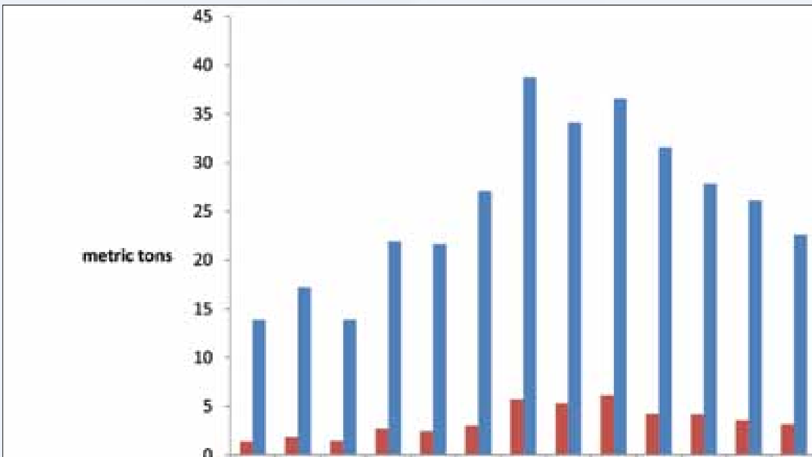
Fish catch per fishing boat has increased from 13.9 metric tons in the year 2000 up to 22.6 metric tons in the year 2012. The peak was in the year 2006 with 38.8 metric tons of fish caught per fishing boat.

Fish catch per fishing boat has increased from 13.9 metric tons in the year 2000 up to 22.6 metric tons in the year 2012. The peak was in the year 2006 with 38.8 metric tons of fish caught per fishing boat.

Fish catch per fisherman has more than doubled up from the year 2000 until 2012. In 2000 the average fish catch per fisherman and year was 1.4 metric tons which has increased to 3.2 metric tons in the year 2012.

The peak was the year 2006 with 38.8 metric tons of fish per fishing boat and 5.7 metric tons of fish per fisherman. Since 2007 both values are decreasing. See Figure 57.

Figure 57: Annual fish catch per fishing boat and per fisherman (2000 – 2012)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fish catch per boat	13.9	17.2	13.9	21.9	21.6	27.1	38.8	34.1	36.5	31.5	27.8	26.1	22.6
Fish catch per fisherman	1.4	1.9	1.5	2.7	2.5	3.0	5.7	5.3	6.1	4.2	4.2	3.6	3.2

Data source: MoE, calculated by MDPS

9 Pesticides

9.1 Rationale

Pesticides are used in Qatar for agricultural purposes (herbicides, fungicides, insecticides), to protect palm trees and parks from insects and to combat insects in government building and households. Intense use of pesticides can have dangerous effects on the environment and public health.

Currently detailed statistics about the actual application of pesticides in terms of quantity of active agent are not available. But statistics can be shown in terms of pesticides imported.

9.2 Key messages

a) Detailed statistics about the actual application of active agents are not available. Therefore data on imported pesticides (total mass) have to be used.

b) The total import of pesticides increased by 98% from 2009 – 2012.

9.3 Statistics and Indicators

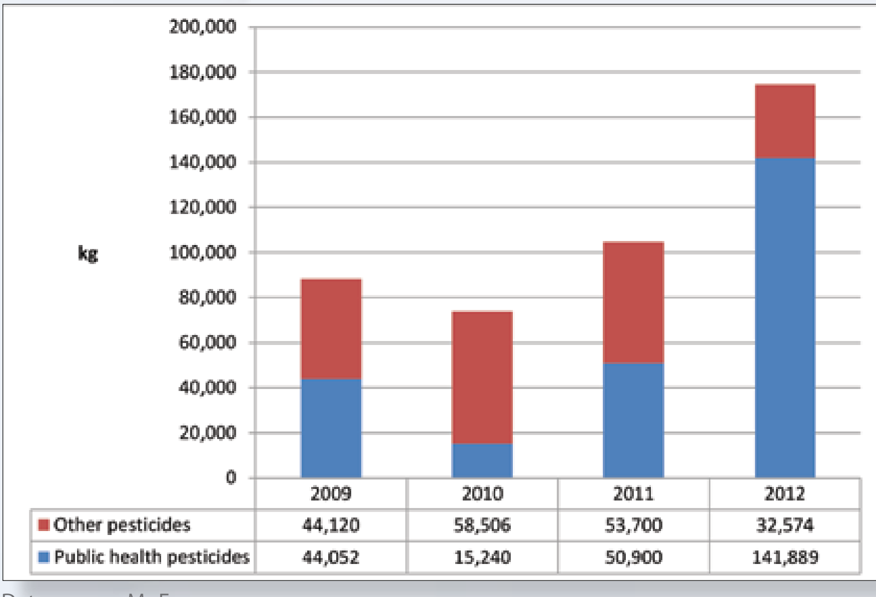
From 2009 – 2012 the total import of pesticides increased from 88,172 kg to 174,463 kg (+98%). The increase is dominated by pesticides used for public health (from 44,052 kg in 2009 up to 141,889 kg in 2012). See Table 17 and Figure 58.

Table 17: Pesticides imported 2009-2012

Import of pesticides (kg)	2009	2010	2011	2012
Public health pesticides	44,052	15,240	50,900	141,889
Insecticides	18,563	8,300	10,900	25,424
Fungicides	0	7,791	3,400	3,150
Herbicides	1,152	1,264	0	4,000
Pesticides (not further specified)	24,291	41,149	39,400	0
Growth regulators	114	3	0	0
Total	**88,172**	**73,746**	**104,600**	**174,463**

Data source: MoE

Figure 58: Pesticides imported for public health compared to pesticides imported for other purposes (agricultural, protection of palm trees and parks) 2009 - 2012



Data source: MoE

10 Solid wastes and wastes management

10.1 Rationale

The amount, composition and management of wastes provide insights into a country's efficiency into using materials and resources. The amount and types of wastes produced in Qatar are directly linked to the size of its population and activities as well as to the business sectors that drive the economy.

Households in Qatar are mainly generating "domestic wastes" which include paper, packaging, yard trimmings, food and some "bulky wastes" referring to furniture, air conditioners, etc. Finally households also discard small amounts of hazardous wastes.

Commercial, government and public offices and services generate larger amounts of these municipal wastes and sometimes also larger quantities of hazardous wastes.

Industrial activities transform raw materials into different products that satisfy our needs. However, during these processes they generate "municipal and hazardous wastes". Hazardous wastes are defined as such because of their characteristics -toxicity, corrosiveness, ignitability and reactivity- which make them potentially harmful to the environment or to human health. Among this type of wastes we can find chemicals wastes, acids, alkaline, contaminated soils, etc.

Construction in Qatar is an economic sector that is growing fast and it generates wastes such as concrete formworks, pipes, ceramics, glass, metal, iron and steel, etc.

Finally, the transport sector and the use of private cars in Qatar is also a source of another type of waste flow: tires.

The QNDS 2011-2016 targets related to waste management are the following:

- Establish a solid waste management plan, strongly emphasizing recycling
- Recycle 38% of solid waste
- Contain domestic waste generation at 1.6 kg per capita per day

10.2 Key messages

a) Waste generation has been rising since 2008, from 8.26 million tons a year to 12.25 million tons a year 2012. Qatar's construction sector is the main source of wastes, as it accounts for 79.22% of the total wastes generated in 2012.

b) From 2008 to 2012 the per capita domestic waste generation rate has remained between 1.37 to 1.30 kg per person per day.

c) 2,387 tons of domestic wastes were generated daily in 2012 which means an average per capita generation of 1.30 kg/day. However, if we include the generation of bulky wastes and tires the per capita generation of municipal wastes became 3.79 kg/day.

d) In 2012 about 95% of the wastes were disposed in landfills. However, State waste management infrastructure will use the energy content of waste and will transform it to provide energy.

e) Qatar has built the infrastructure needed to convert wastes into products: 684 tons per day of compost and fertilizers and 42 MW of energy of which 66% will be net provision to the grid.

f) This report shows some items regarding the trend of the generation and management of waste management in the country. However, to be able to characterize the full waste balance from generation and a detailed description of its management activities (collection, treatment, recovery and disposal) some coordination activities are needed among different government institutions as well as the private sectors. Making these data available will allow to:

- have a detailed characterization of key waste streams relevant to Qatar such as electronics, recyclables or food waste. Identifying the food waste stream may contribute to create measures to reduce it and therefore, enhance the country's food security;
- attend the priorities identified by the NDS review, and
- link products, Qatar's urban lifestyle and the recycling industry.

10.3 Statistics and Indicators

Waste generation and waste management

Table 18 presents the total amount of solid waste generated and managed (excluding hazardous waste). It is an attempt to show an initial waste balance by wastes type from waste generation to waste treatment and recycling. However, several values still deviate from other national reports which might be an issue of different classification systems and conversion factors used. More investigation is needed to resolve these remaining questions regarding waste quantities.

Table 18: Generation of waste by type and waste management facility from 2008-2012 (metric tons)

Wastes* by type	Waste management facility	Generation of waste by type and waste management facility (metric tons)				
		2008	2009	2010	2011	2012
Domestic	Umm Al-Afai	742,552	782,323	846,630	628,235	44,151
	Mesaieed	0	0	0	0	258,991
	DSWMC	Not apply	Not apply	Not apply	187,067	568,466
	Total Domestic	**742,552**	**782,323**	**846,630**	**815,302.28**	**871,608.28**
Construction**	Rawdat Rashid	5,366,550	7,715,625	8,864,475	9,099,486	9,228,296
	Umm Al Afai	382,366	283,231	338,987	470,298	59,086
	Mesaieed	0	0	0	0	419,503
	Total Construction	**5,748,916**	**7,998,856**	**9,203,462**	**9,569,784**	**9,706,885**
Bulky	Umm Al-Afai	1,751,159	1,934,543	1,748,989	1,751,101	304,259
	Mesaieed	0	0	0	0	1,340,776
	Total Bulky	**1,751,159**	**1,934,543**	**1,748,989**	**1,751,101**	**1,645,035**
Tires***	Rawdat Rashid	0	0	0	21,353	2,726
	Umm Al-Afai	14,200	16,244	18,519	0	0
	DSWMC	Not apply	Not apply	Not apply	0	21,885
	Total Tires	**14,200**	**16,244**	**18,519**	**21,353**	**24,611**
Other	Umm Al-Afai	2,699	6,649	5,030	5,931	558
	Mesaieed	0	0	0	0	4,797
	Total others	**2,699**	**6,649**	**5,030**	**5,931**	**5,355**
Substance		**8,259,526**	**10,738,615**	**11,822,630**	**12,163,471**	**12,253,494**

Missing values in the original data sources were assumed to be zero

*Waste generation does not include hazardous wastes and it is assumed that all wastes that are generated are collected.

**Construction wastes data were estimated using a conversion factor of 22 tons per trip.

***Tires were estimated using a conversion factor of 30.77 kg per piece collected.

Data source: MoE, calculation to construction wastes and tires by MDPS based on number of trip (trucks) and number of tires.

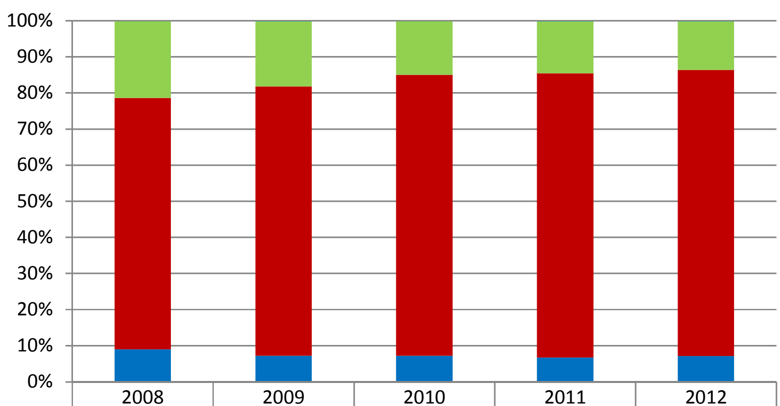
Table 19 presents the daily generation of wastes according to type since 2008 (basic assumption that waste managed is equal to waste generated). Figure 58 shows the same information in percentage per waste type. It shows that construction waste has increased from 69.60% of the total waste generated in 2008 to 79.22% in 2012.

Table 19: Daily waste generation from 2008-2012 (metric tons per day)

Wastes by type	Daily waste generation (metric tons)				
	2008	2009	2010	2011	2012
Domestic	2,034.39	2,143.35	2,319.53	2,233.70	2,387.97
Construction	15,750.45	21,914.67	25,214.96	26,218.59	26,594.21
Bulky	4,797.70	5,300.12	4,791.75	4,797.54	4,506.95
Tires	38.90	44.50	50.74	58.50	67.43
Other	7.39	18.22	13.78	16.25	14.67
Total	**22,628.84**	**29,420.86**	**32,390.77**	**33,324.58**	**33,571.23**

Data source: MoE, calculation to construction wastes and tires by MDPS based on number of trips and number of tires.

Figure 59: Percentage of waste generated per waste type 2008 – 2012

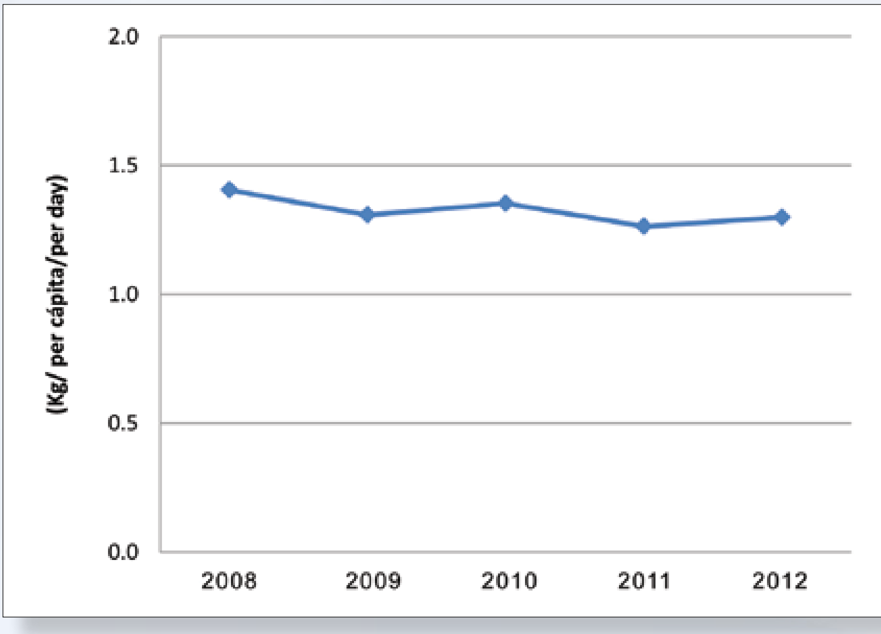


	2008	2009	2010	2011	2012
Other	0.03%	0.06%	0.04%	0.05%	0.04%
Tires	0.17%	0.15%	0.16%	0.18%	0.20%
Bulky	21.20%	18.01%	14.79%	14.40%	13.43%
Construction	69.60%	74.49%	77.85%	78.68%	79.22%
Domestic	8.99%	7.29%	7.16%	6.70%	7.11%

Data source: MoE, calculation to construction wastes and tires by MDPS based on number of trips and number of tires.

The per capita generation of domestic shows a slightly decreasing trend from 1.40 in 2008 to 1.30 kgs/person/day in 2012. Waste generation per capita per day has been below the QNDS target of 1.6 kg per capita per day. See Figure 60.

Figure 60: Daily domestic waste generation per capita from 2008-2012. (kg/ per capita/ per day)



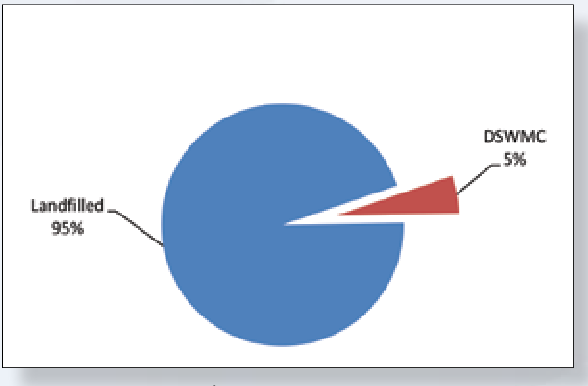
Data sources: MoE and MDPS

Waste management

Once wastes are generated -in order to prevent impacts to the environment or to our health- they must be managed. Wastes management activities include source separation, collection, transportation, storage, reused, recycling, processing, treating or they might be sent to disposal in landfills. Due to consistency and availability of data for waste management activities further detail of activities will not be presented in this report

In 2012, 95% of wastes in Qatar were sent to landfills. The other 5% is being managed in the DSWMC which initiated operation in 2011 and is managing a daily average of 1,557.44 tons. Two thirds of these wastes are subject to energy recovery, composting and recycling. See QDB (2013).

Figure 61: Percentage of wastes managed by management activity (2012)

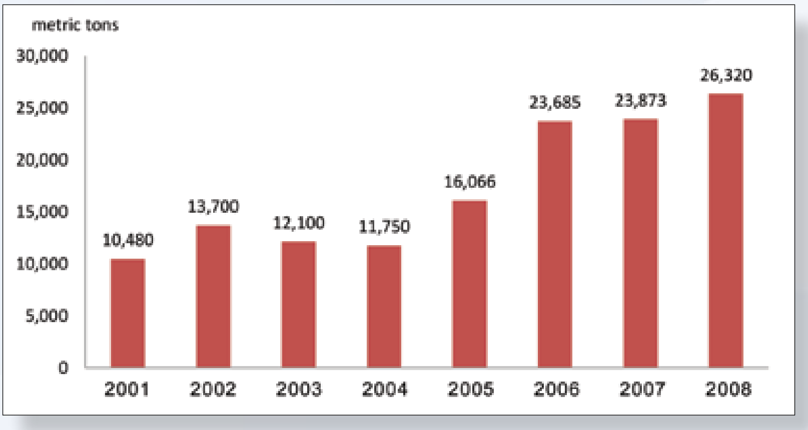


Data sources: MoE and QDB

Recycling and Resource Productivity: from wastes to products

Wastes are increasingly seen as an important source of raw materials. Recycling means that some wastes are recovered to be used as materials and create new products. For several years wastes such as plastics, paper or scrap iron collected from households and businesses have been recovered at source or before their disposal in the landfills and sent to private companies to be reused or recycle. From 2001 to 2008, the volume of wastes recycled has grown by 151%. However, for the years after 2008, data available was not consistent, so it is not included in this report.

Figure 62: Recycled Wastes (metal, plastic and paper) from 2001 to 2008 (metric tons)



Source: QSA &DI (2012a)

The Domestic Solid Wastes Management Centre in Qatar began to operate in 2011. One of its components is a compost plant. Composting means that green wastes coming from gardens and the organic material coming from food wastes discarded as municipal solid wastes will be transform as compost and fertilizer and use for park maintenance, gardening and landscaping as well as in agriculture.

This plant has an installed capacity to use approximately 750 tons of biodegradable wastes daily and after 3 process phases it may produce 429 tons a day of compost and 255 tons a day of liquid fertilizer. During the processing, the organic matter produces biogas that provides up to 6.8 MW electricity and heating for digestion process.

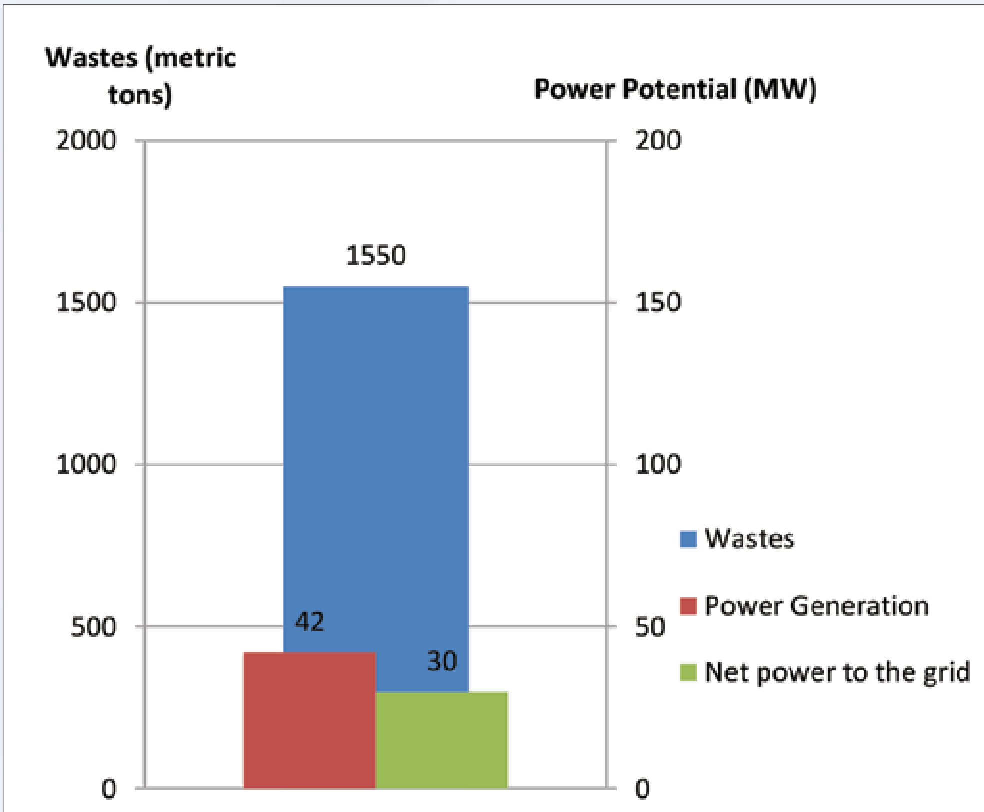
Table 20: Wastes to Products Potential (metric tons per day)

DSMWC	Production Potential Metric tons/day
Compost	429
Liquid Fertilizer	255

Data source: Source: Keppel Seghers (2013)

Wastes can also be used to produce energy. Some wastes can be used to power facilities and produce electricity and heat at the same time. Another facility included in the DSWMC is an electric utility which generates power based on municipal solid waste. Using 1,550 tons of wastes it has a potential of generating 42 MW and provides 30 MW to the grid.

Figure 63: Wastes to Energy Potential (metric tons, MW)



Data source: Keppel Seghers (2013)

With both facilities, the compost and the energy recover plants. Qatar has now an installed capacity of 48.8 MW of power generation based on wastes.

11 List of Acronyms

bcm	Billion metric cubic metres
BOD	Biological Oxygen Demand
CFC	Chlorofluorocarbon
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dS/m	Decisiemens per meter
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSDP	General Secretariat for Development Planning
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
LTAA	Long-term Annual Average
MDPS	Ministry of Development Planning and Statistics
MMSCM	Million Metric Standard Cubic Meters
MMUP	Ministry of Municipality and Urban Planning
MoE	Ministry of Environment
MoEI	Ministry of Energy and Industry
MW	Megawatt
N_2O	Nitrous Oxide
NMVOC	Non-Methane Volatile Organic Compounds
NO_x	Nitric Oxide
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substance
PM	Particulate Matter
QDB	Qatar Development Bank
QMD	Qatar Meteorological Department
QSA	Qatar Statistics Authority
SO_2	Sulphur Dioxide
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UWWTP	Urban Wastewater Treatment Plant
WHO	World Health Organization
WMO	World Meteorological Organization

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