دائـــــرة الـــطـــاقـــة
DEPARTMENT OF ENERGY

2023 ANNUAL TECHNICAL REPORT

For the Water, Wastewater, Electricity and District Cooling Sector in the Emirate of Abu Dhabi

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1. Introduction

Welcome to our 2023 Annual Technical Report for the water, wastewater, electricity, and District Cooling (DC) sectors in the Emirate of Abu Dhabi.

This report is issued every year by the DoE using information and data gathered from a range of regulatory submissions provided by our licensees every year. The aim is to highlight major milestones such as our sector's role in delivering the Emirate's strategic objectives as well as providing an overview on performance metrics we use to measure how our sector is creating value for our communities, customers, investors, and the environment.

2. Glossary

AADC	Al Ain Distribution Company
ADDC	Abu Dhabi Distribution Company
ADNOC	Abu Dhabi National Oil Company
ADSSC	Abu Dhabi Sewerage and Services Company
AMPC	Al Mirfa Power Company
APC	Arabian Power Company
BOD5 (ATU)	The biochemical oxygen demand of wastewater during decomposition occurring over a 5 day period.
CFU/100ml	Colony Forming Unit per 100 milliliter
COD	Commercial Operation Date
CS	Carbon Steel
CSP	Concentrated Solar Power
DC	District Cooling
DEL	Dolphin Energy Limited
DI	Ductile Iron
DISCOs	Distribution Companies
DMA	District Metered Area
DMP	Distribution Metering Point
DN	Nominal Diameter
DW	Drinking Water
DWSP	Drinking Water Safety Plan
EAD	Environment Agency of Abu Dhabi
EB	Al Etihad Biwater Wastewater Company
ECPC-A2	Emirates CMS Power Company
EMAL	Emirates Aluminum
ESWPC- F1	Emirates Sembcorp Water and Power Company
EVSE	Electric Vehicle Supply Equipment
EWEC	Emirates Water and Electricity Company
FAPCO- F2	Fujairah Asia Power Company
FEWA	Federal Electricity and Water Authority
GOR	Gained Output Ratio
GRP	Glass-fiber Reinforced Plastic
GTTPC-A1	Gulf Total Tractebel Power Company
HDPE	High-Density Polyethylene
ICAD	Industrial City of Abu Dhabi
ISTPs	Independent Sewage Treatment Plants
IWA	International Water Association
IWPP	Independent Water and Power Producers
Km	Kilometer

KPI	Key Performance Indicator
l/s	Liter per second
LDC	Load Despatch Centre
Lphd	Liters per Household per Day
LSI	Langelier Saturation Index
M	Meter
m3/day	cubic meters per day
MCM	Million Cubic Meter
MCMD	Million Cubic Meter per day
MED	Multiple Effect Distillation
mg/l	Milligrams per Liter
MIG	Million Imperial Gallons
MIGD	Million Imperial Gallons per Day
MIPCO	Mirfa International Power Company
Ml/day	Mega litre per day
MSF	Multi-Stage Flash Distillation
MWh	Mega Watt hour
NE	Northern Emirates
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OPEX	Operational Expenditure
PCOD	Project Commercial Operation Date
PCR	Price Control Returns
PDSRS	Production Data Submission and Reporting System
PPB	Parts Per Billion
PPM	Parts Per Million
PR	Performance Ratio
PWPA	Power and Water Purchase Agreement
RIA	Regulatory Impact Assessment
RPC-S2	Ruwais Power Company
RW	Recycled Water
RWRRS	Recycled Water Reporting System
SCIPCO-S1	Shuweihat CMS International Power Company
SEWA	Sharjah Electricity and Water Authority
SMPs	Sector Measuring Points
STEP	Strategic Tunnel Enhancement Program
SWRO/RO	Seawater Reverse Osmosis
TA	Technical Assessor
TAPCO-B	Plant Taweelah Asia Power Company
TBT	Top Brine Temperature
TDIC	Tourism Development and Investment Company
TDS	Total Dissolved Solids
TEC	Trade Effluent Control

TRANSCO	Abu Dhabi Transmission and Dispatch Company
TSS	Total Suspended Solids
VB	Veolia Besix Waste Water Company
WHO	World Health Organization
WQR	Water Quality Regulations
WQRRS	Water Quality Regulations Reporting System
WTC	Water Transmission Code

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3. Sector Highlights

Annual Production

- Electricity **102,328 GWh**
- Water **1,160 MCM (244164 MIG)**
- Recycled water Production **334 MCM**

Installed Capacity

- Electricity **19,347 MW**
- Water **4.74 MCM/day (1043 MIGD)**
- Wastewater **1333 Ml/day**

System Demand

Electricity

Abu Dhabi system peak reaching **13,273 MW**, while exports to the Northern Emirates peak demand of **5,247 MW.**

Water

Maximum daily inlet water (Supply Peak), **3.70 MCMD (814.85MIGD)**
Maximum daily despatched water (Transmission Peak), **3.55 MCMD (781.09 MIGD)**

Recycled water

Recycled water reuse percentage: **72%**

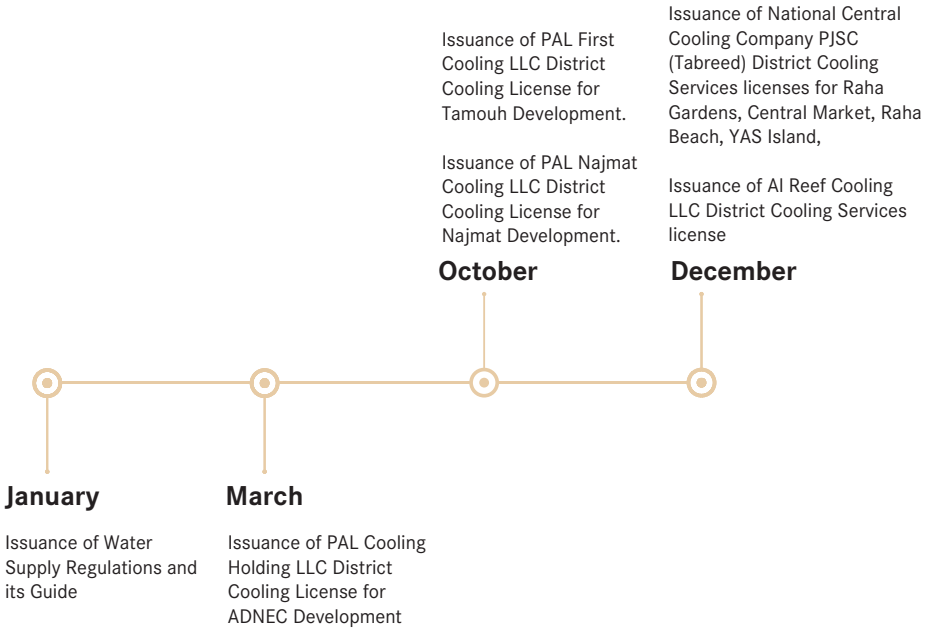
Water Quality Tests Conducted

- Water **153,958**
- Recycled water **98,459**
- Total testing **252,147**

Number of Connected Customers

- Electricity Customers **598,537**
- Water customers **468,567**
- Wastewater customers **458,141**

4. Timeline


January
Issuance of Water Supply Regulations and its Guide
March
Issuance of PAL Cooling Holding LLC District Cooling License for ADNEC Development
October
Issuance of PAL First Cooling LLC District Cooling License for Tamouh Development.
Issuance of PAL Najmat Cooling LLC District Cooling License for Najmat Development.
December
Issuance of National Central Cooling Company PJSC (Tabreed) District Cooling Services licenses for Raha Gardens, Central Market, Raha Beach, YAS Island,
Issuance of Al Reef Cooling LLC District Cooling Services license

5. Electricity and Water

Electricity Generation and Water Production

Generation and Production Overview

Demand Growth

Demand for electricity in the emirate of Abu Dhabi, also known as the global electricity demand, was higher in 2023 than in 2022 indicating strong economic growth. The Global electricity demand in Abu Dhabi peaked at 18,526 MW on 25th of August at 12:38 hrs. Abu Dhabi Emirate recorded a peak of 13,273 MW. Exports to the Northern Emirates peaked at 5,247 MW

Electricity Demand Growth (2000 - 2023)

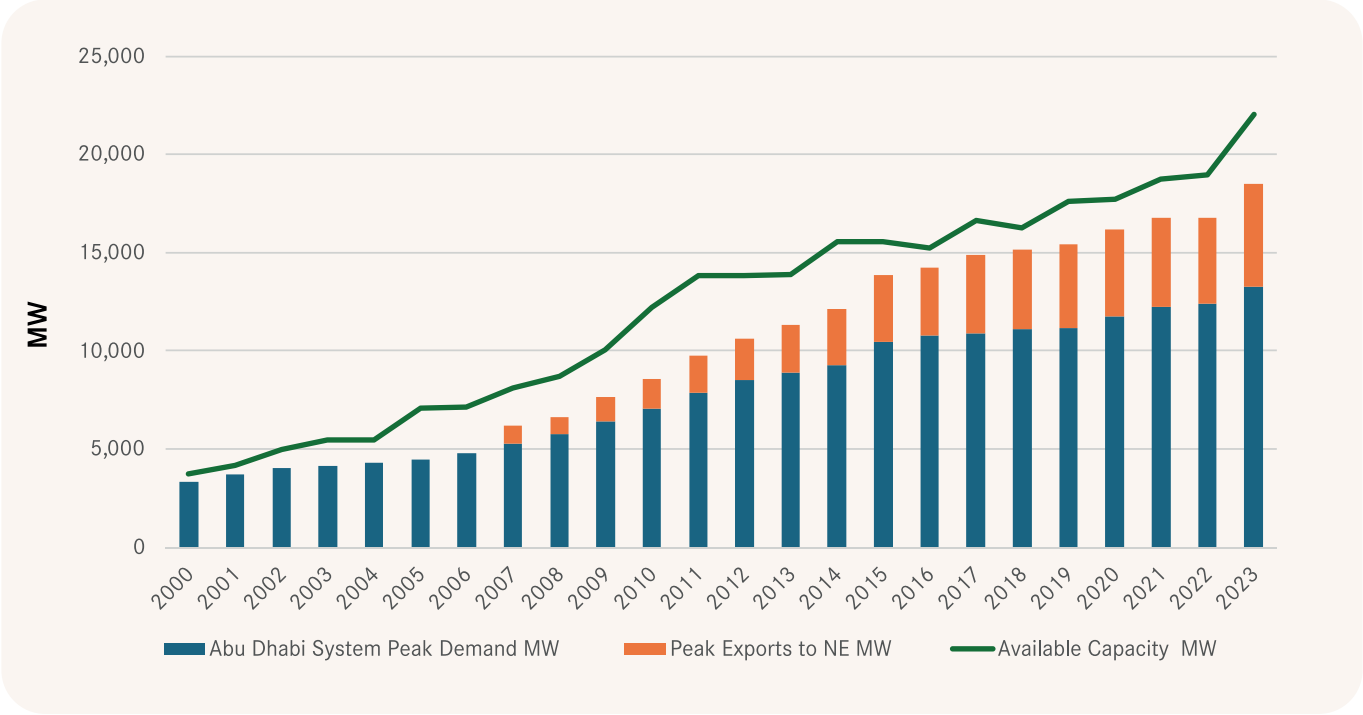


Figure 1 Electricity Demand Growth (MW)

The Global water demand in Abu Dhabi is also measured by Abu Dhabi regional system demand and the demand resulting from the exports to the Northern Emirates. In 2023, the global water supply demand peaked at 3.59MCMD (790 MIGD). Water global supply peak demand remained stable in 2023 with a decrease of 1.91% from 2022. Abu Dhabi Emirate accounted for 93% of peak supply demand represented by 3.34 MCMD (735MIGD) while supply to the Northern Emirates accounted for 7% of peak supply demand and represented 0.25 MCMD (55 MIGD).

Water Demand Growth Overview (2000 - 2023)

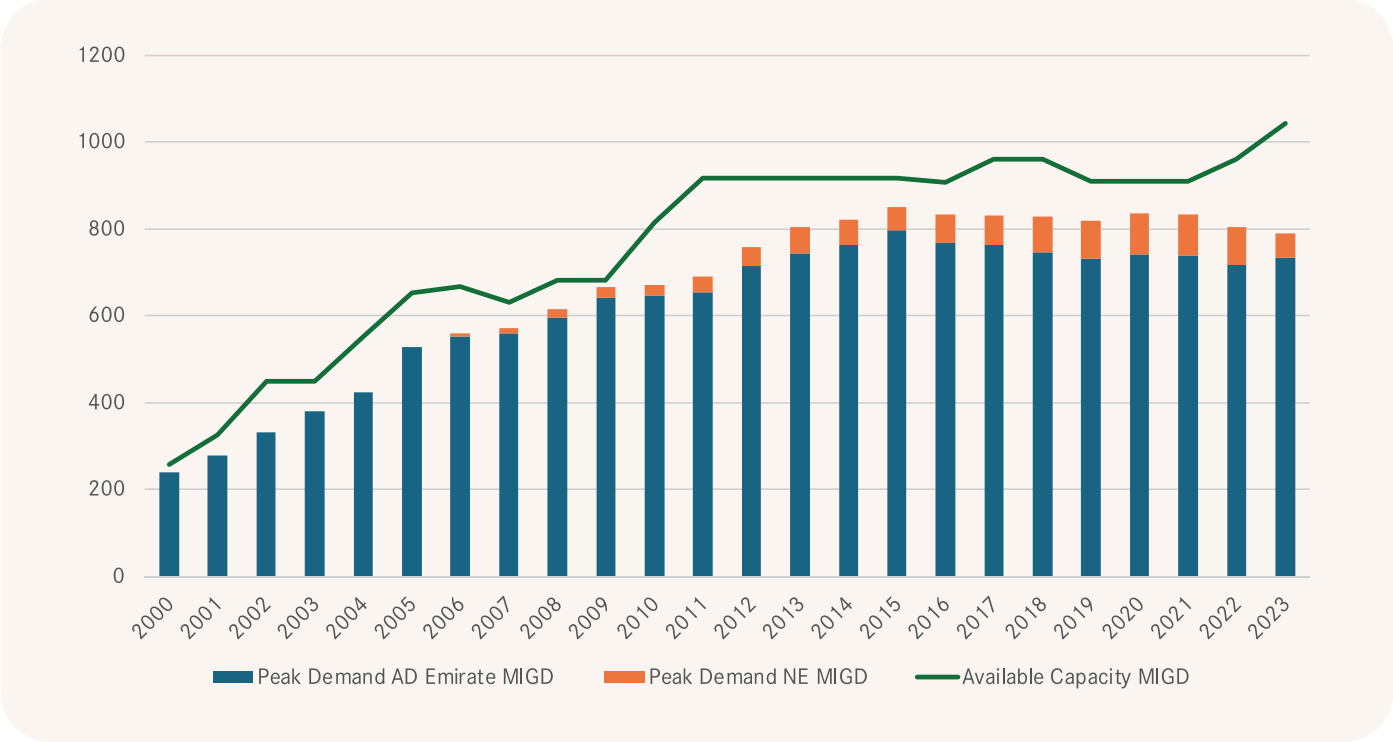


Figure 2 Water Demand Growth

Global Electricity and Water Capacity and Production

To support Abu Dhabi's demand for electricity and water and underpin the security of supply, our energy sector has a total available electricity generation capacity of 22,036 MW and water production capacity of 4.14 MCMD (1043 MIGD). The total electricity generated was 102,328 GWh, while the total water produced was 1160 MCM (255,164 MIG) in 2023.

Water Production Capacity 2023

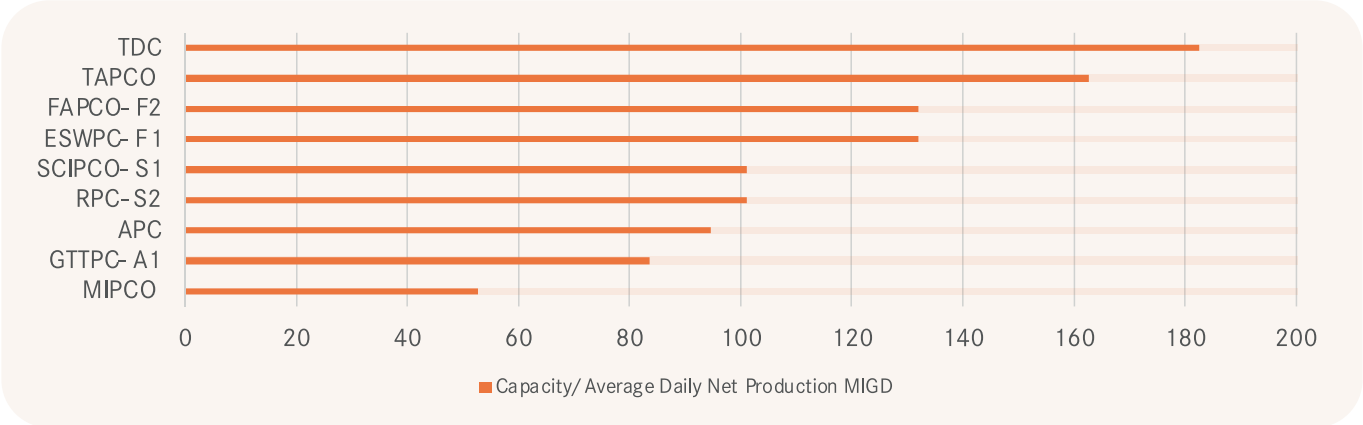


Figure 3 Water Production Capacity

Electricity Generation Capacity 2023 (MW)

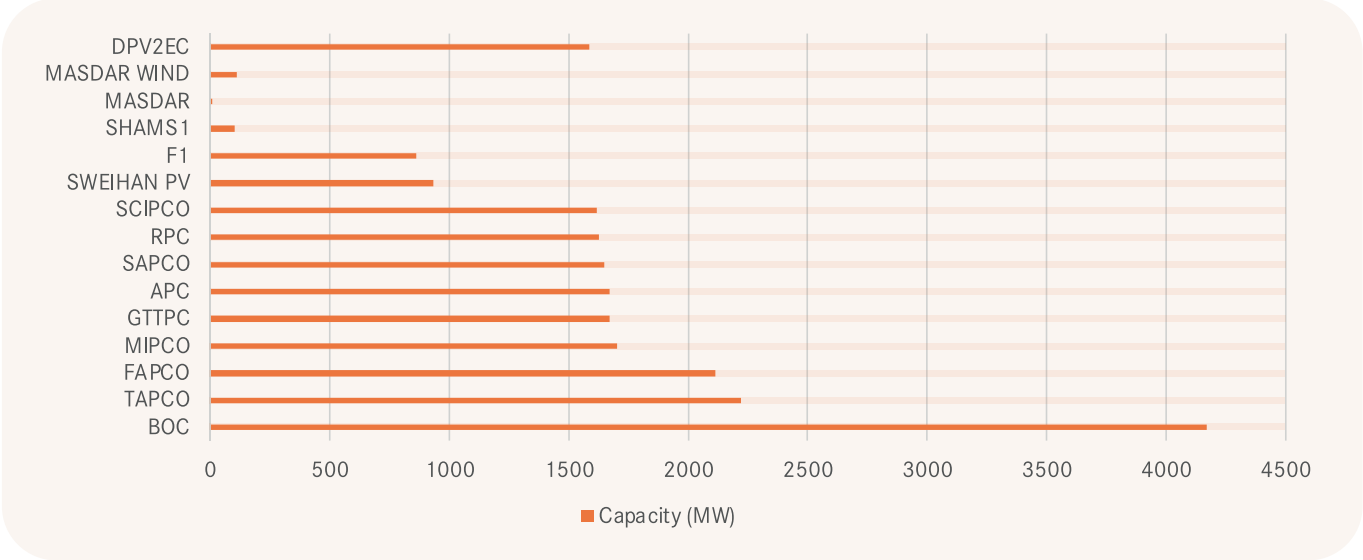


Figure 4 Electricity Generation Capacity

Electricity and Water Production by Company

In terms of electricity generation markets, there are 15 power providers with electricity generation market shares ranging from 0.06 % up to 32% during 2023. BOC holds the largest market share of 32%. Figure 5 below shows all IWPPs generation market shares.

Water production capacity shares among 9 IWPPs range from 5% to 24%.%. Nearly 24% of the overall water production capacity share lies within TDC. This is followed by ESWPC F1 and FAPCO F2 each holding around 13 % and 12% respectively during 2023. The Taweelah RO Desalination Company COD2, with a capacity of 83.3 MIGD, contributed to a total of 183.33 MIGD, achieved on 15 April 2023.

Desalination Gross Production Contribution by Licensee

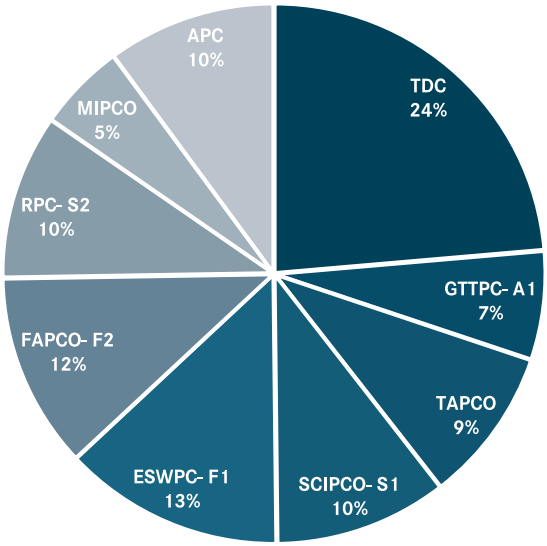


Figure 5 Water Production by Company

Electricity Generation Contribution by Licensee

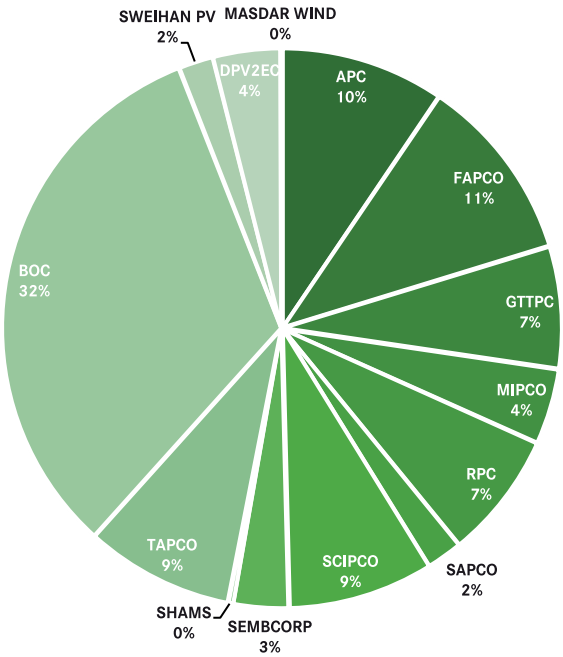


Figure 6 Electricity Production by Company

Electricity and Water Production Mix

As for electricity generation in Abu Dhabi, Renewables from MASDAR Wind, Masdar, Shams, Sweihan PV, Al Dhafra PV2 accounted for around 6.3% of the electricity generation mix in Abu Dhabi, and Electricity Generated from Barakah Nuclear Power Plant 3 Units, accounted for 32%. The major share of Electricity Generation of 76% is accounted by the traditional CCGT, Co-Gen, and OCGT plants.

The share of clean energy will continue to grow in the coming years with the addition of the Unit 4 of Barakah Nuclear Energy unit with the expected commercial operation date in 2024. The plant will have a total of 5,600 GW of renewable energy to the grid when fully operational.

As for Water production, Figure 7 demonstrates an eight years year overview of the IWPPs annual production contribution percentage by technology. MSF production capacity has decreased mainly due to APC UAN East and West and ECPC water capacity retirement in 2019 and 2021 respectively and TDC achievement of COD2 of 183.33 MIGD. Moreover, RO desalination contribution is anticipated to significantly grow over the coming years. In 2023, the RO production has increased by 46% and the MSF and MED production has decreased by 19.3% and 6% respectively in comparison to 2022.

IWPPs Desalination Gross Production Contribution by Technology % Benchmarking- Overview- (2016- 2023)

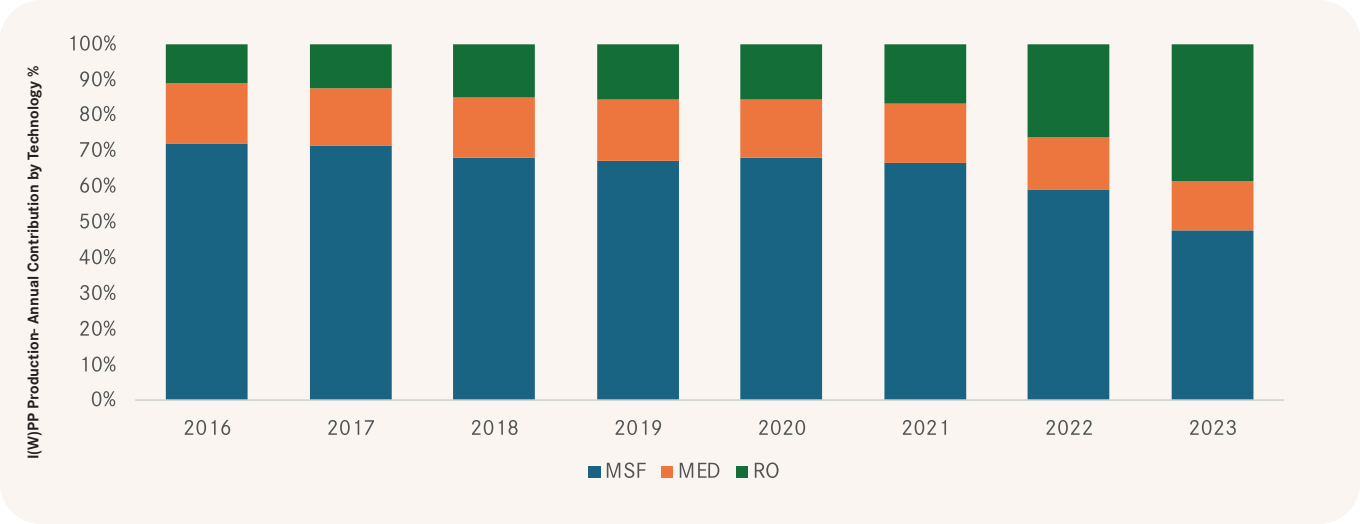


Figure 7 Water Production by Technology

Figure 8 shows the daily electricity generation at peak time in MWh for the last three years. It reflects the annual variation in demand which is seasonal in that it closely follows the weather and is consistent year on year. Certainly, the annual peak coincides with the mid-summer peak demand mentioned above.

Global demand has grown by 13% in 2023 while Exports to the Northern Emirates grown by 19% and demand from Abu Dhabi Emirate has also grown by 8.7%.

Daily Energy Generation (MWh) - 2021,2022,2023

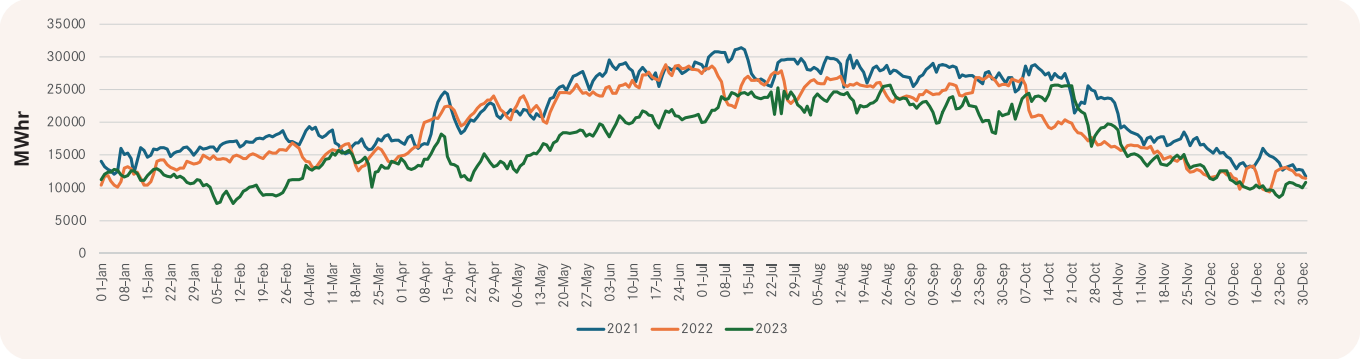


Figure 8 Daily Energy Generation

Unlike electricity, water demand in the Emirate of Abu Dhabi exhibits moderate seasonal fluctuations throughout the year. The weekly average water production in 2023 is provided in Figure 9 below. The global water demand reached its peak of 3.72 MCMD (818 MIGD) on 17 June 2023, which represents an increase of 1.88% compared to last year's peak of 3.65 MCMD (803 MIGD) on September 23, 2022 . Minimum production of 2.28 MCMD (502 MIGD) occurred on February 06, 2023 compared to a minimum production of 2.13 MCMD (468 MIGD) that occurred on 4 January 2022, hence an increase of 7% . The production changes in particular in the first and second quarters of 2023 (winter and summer seasons) was mainly due to change in demand, planned outages, and to a lesser extent forced outages.

Average Water production by IWPPs (2021-2023)

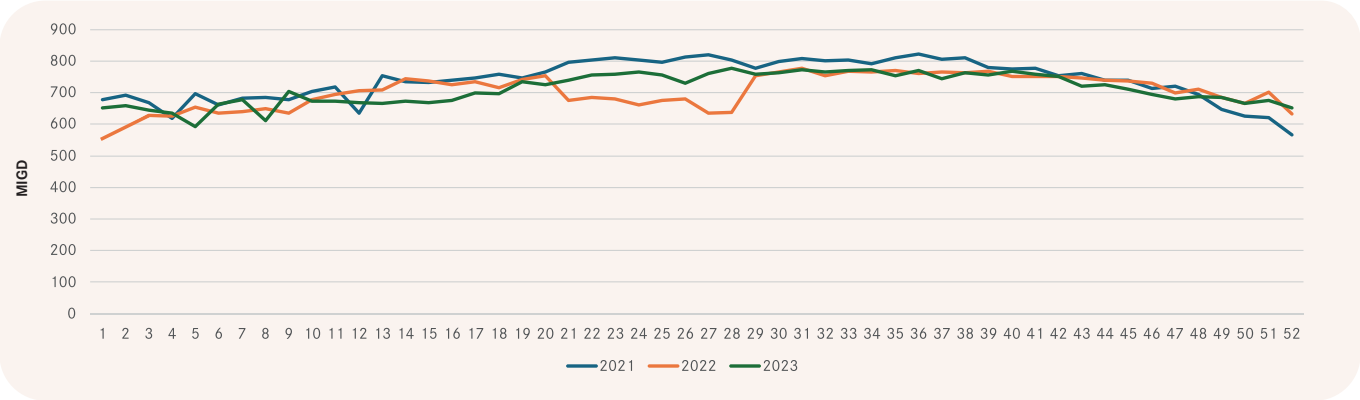


Figure 9: Average Weekly Water Supply by IWPPs (2021-2023)

Global Fuel Consumption 2023:

Natural Gas remained the predominant fuel type used within the sector to generate electricity and produce water in Abu Dhabi. Both ADNOC and DEL continued supplying the sector with natural gas throughout the year without the need to burn any back-up fuel more than the regular amounts used to carry out operational tests to maintain liquid fuel supply system ready on standby if needed. It is reported that both ADNOC and DEL have delivered around 607,636,436 MBTU of natural gas to the sector, which is 11% less than last year (782,755,804 MBTU). This decrease in the annual fuel consumption is due to more transition towards clean energy generation (Wind, Solar, and Nuclear Energy).

Electricity Generation System Performance

In terms of the performance of the generation plants, the available plant capacity was maintained with reasonable capacity margins throughout the year. The below figure shows the plants average reliability percentage for 2023 as reported by each plant. Overall, most of the generation plants reported high reliability index.

Plants Reliability (%)

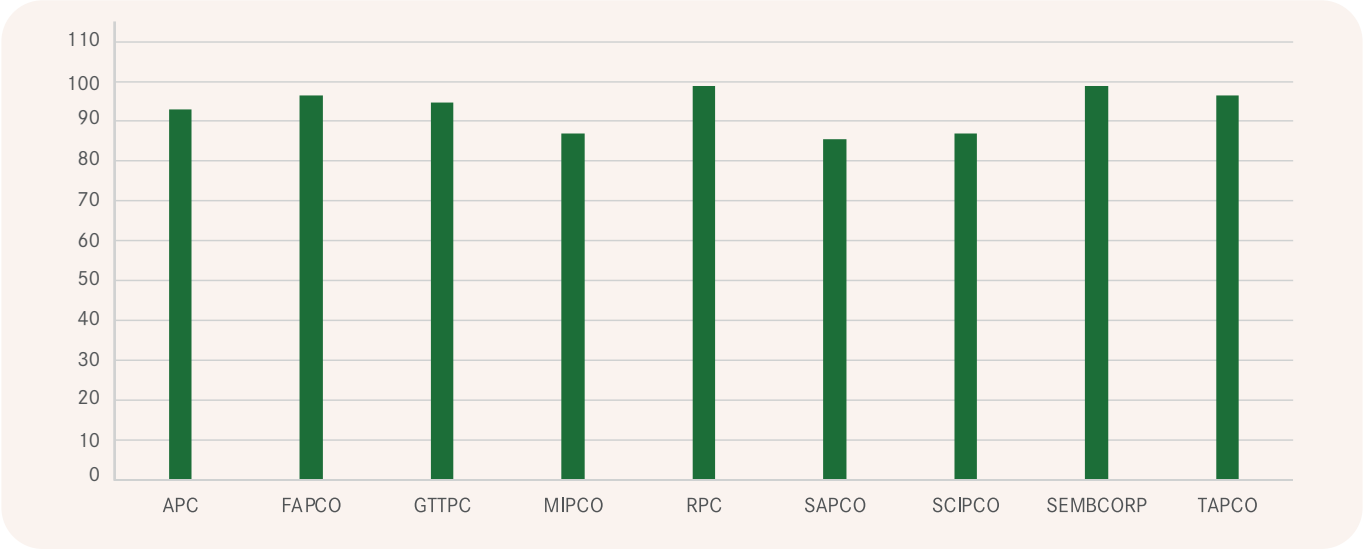


Figure 10: Plants Reliability

Water Production System Performance

In terms of the performance of the water production plants, the available plant capacity in terms of the performance of water production plants and plants' reliability has been maintained with reasonable capacity margins throughout the year. The below diagrams show the plants average reliability percentage for 2023 as reported by each plant. Overall, all of the water production plants reported robust reliability index. The slight decrease in reliability for thermal and reverse osmosis plants is mainly influenced by operation and maintenance. The average reliability for thermal and reverse osmosis plants for 2023 is 97.36% and 96.67% in comparison to 98.11% and 98% in 2022.

IWPPs Reverse Osmosis Desalination Reliability % Benchmarking- Overview- (2023)

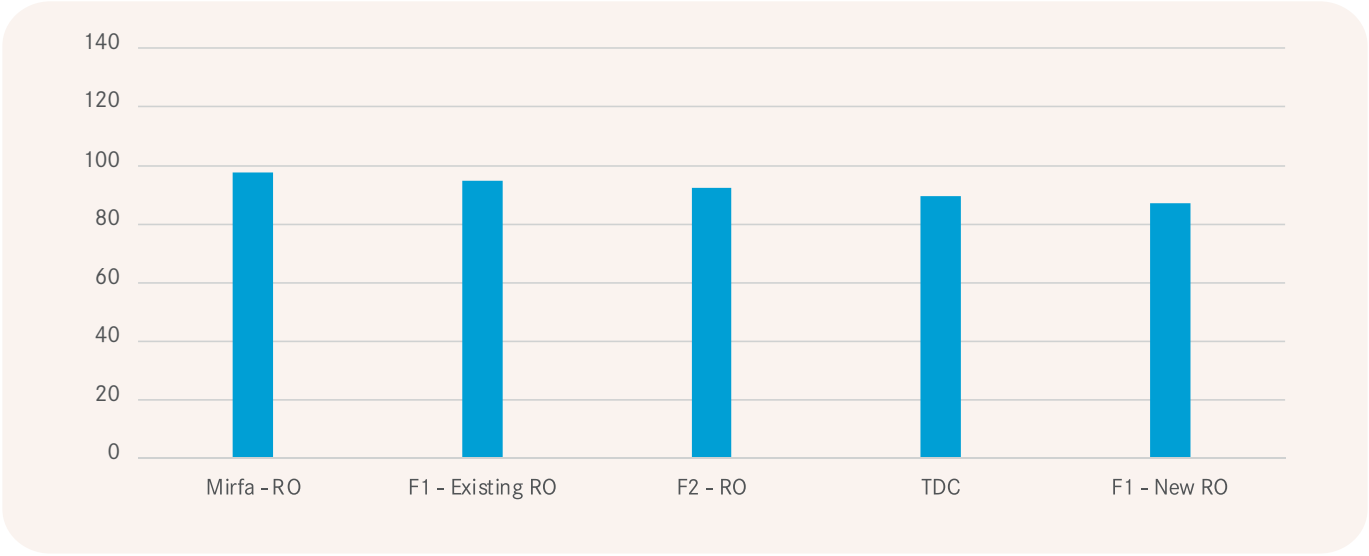


Figure 11 Plants Reliability - RO

IWPPs Thermal Desalination Reliability % Benchmarking- Overview- (2023)

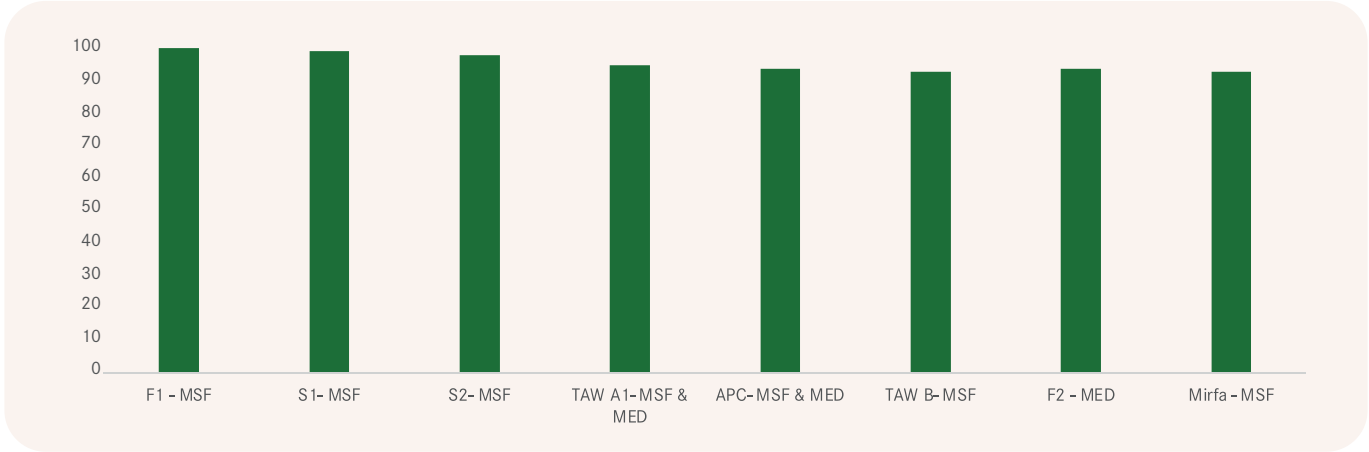


Figure 12 Plants Reliability - Thermal

Desalination Process- Thermal Water Production Performance

Thermal water production efficiency can be measured by performance ratios. Performance ratios are stipulated in the PWPAS and defined as the mass of distillate produced per heat input.

Performance ratio provides an overview of the desalination process efficiency measurement. It defines the relationship between two mass flows i.e., the distillate and the flow of the heating steam.

The sector has maintained a steady performance ratio. Its calculation is influenced by factors such as, performance calculation methodology, analysers accuracy and calibration, operation and maintenance, plant operating conditions, assets ageing and chemical dosing. Figures 13 and 14 below depict five years overview of the average performance ratio for MSF and MED thermal desalination technologies for potable water production.

IWPPs Average MSF Performance Ratio Overview- (2019- 2023)

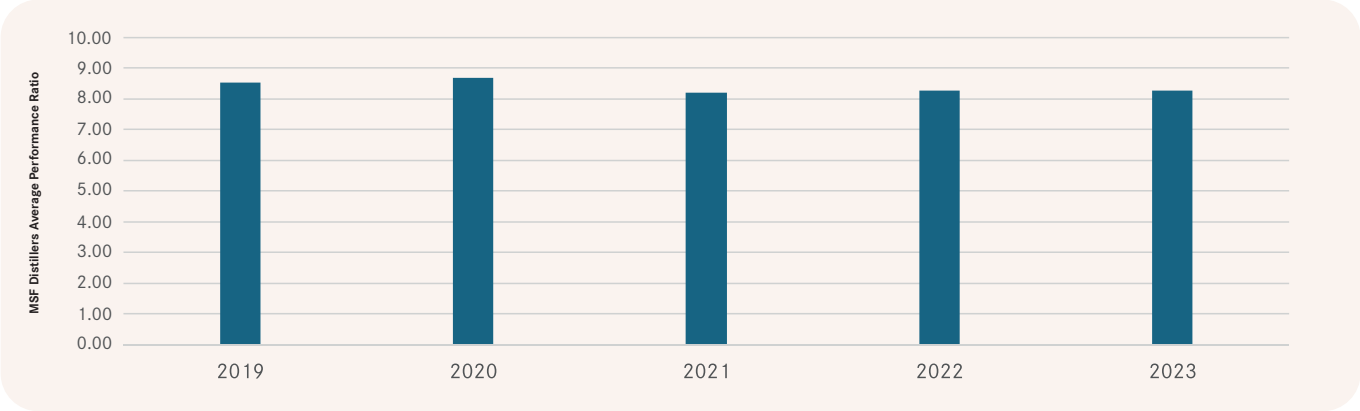


Figure 13 I(W)PPs Desalination Desalination Technology Performance- MSF Average Performance Ratio

IWPPs Average MED Performance Ratio Overview- (2019- 2023)

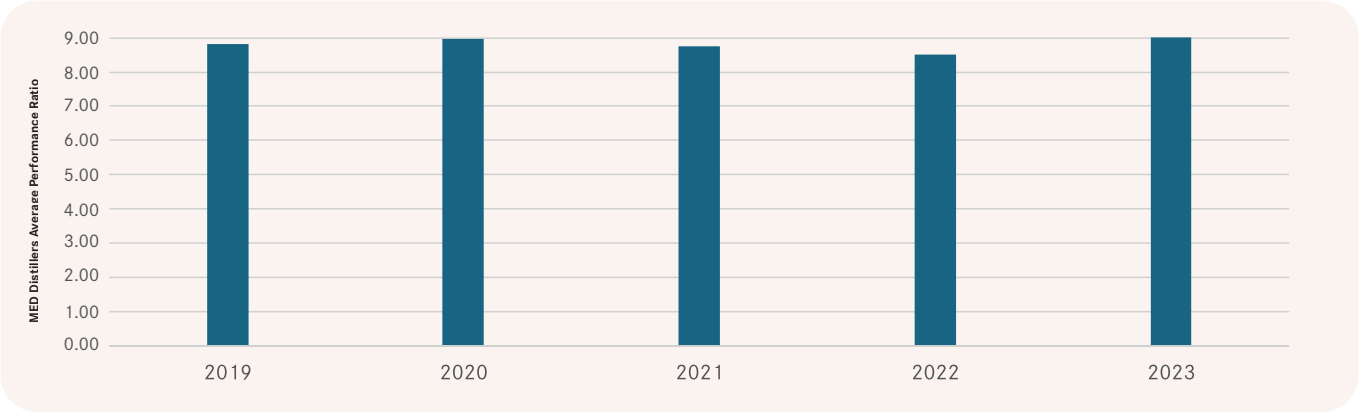


Figure 14 I(W)PPs Desalination Desalination Technology Performance- MED Average Performance Ratio

Water Quality Regulatory Performance - Production

Desalination- IWPPs

The production water quality sampling and testing is conducted as per the WQR regulatory prerequisites. The sample must be representative of the water quality at the time of sampling, its collection program is made with sampling frequency from predetermined locations at equal intervals over the year and it must be analysed as soon as practicable after it has been taken.

The total number of tests completed by the IWPPs in 2023 was 52,052 with 64 water quality parameters examined for RO and 51 water quality parameters examined for thermal desalination respectively. The overall water quality testing frequency compliance (measure of the number of tests conducted against those required) for the production companies was 99.58%.

The overall water quality compliance for 2023 was 99.33%, with Physical Parameters and Microbial Parameters compliance at 99.15% and 100% respectively.

The figure below depicts five years overview of the IWPPs consistent overall water quality compliance.

IWPPs Water Quality Regulatory Compliance Benchmarking %- Overview- (2019 - 2023)

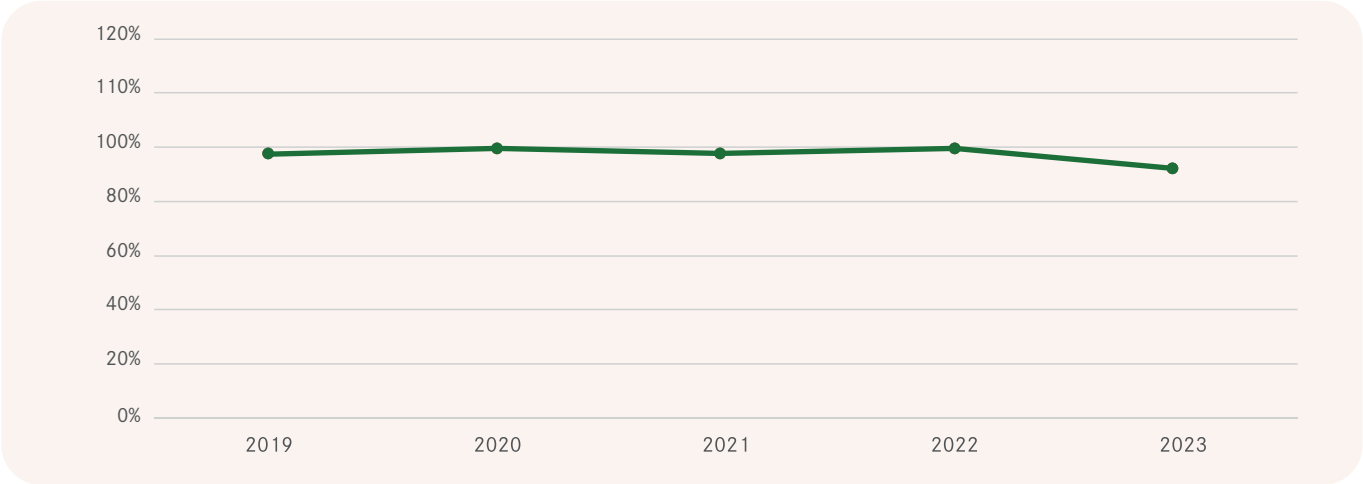


Figure 15 IWPPs Water Quality Regulatory Compliance- %

Desalination Process - Chemicals and Products that come in contact with Water - Regulatory Overview

To ensure regulatory compliance, maintain security of supply and optimize process operation, production licensees submit to the DoE applications to put in use chemicals in the desalination process. These chemicals are administered under the Water Quality Regulations. Chemical regulations also include the transmission and distribution networks.

Improvements in desalination chemicals like anti-scalants and using more durable and reliable material of construction are best practices that have reduced the cost of desalination in particular the investment cost and unit water cost. Performance improvements will also drive down the operating cost.

Figure 16 below depicts five years overview of the chemicals and products that come in contact with water regulatory foundation for RO, MSF and MED. The number of no objections to use new chemicals have increased steadily. Chemical trials have been conducted in thermal, RO, remineralisation and disinfection plants. The regulatory framework underpins the desalination production security of supply.

Chemicals Use in Drinking Water Benchmarking- Overview- (2019- 2023)

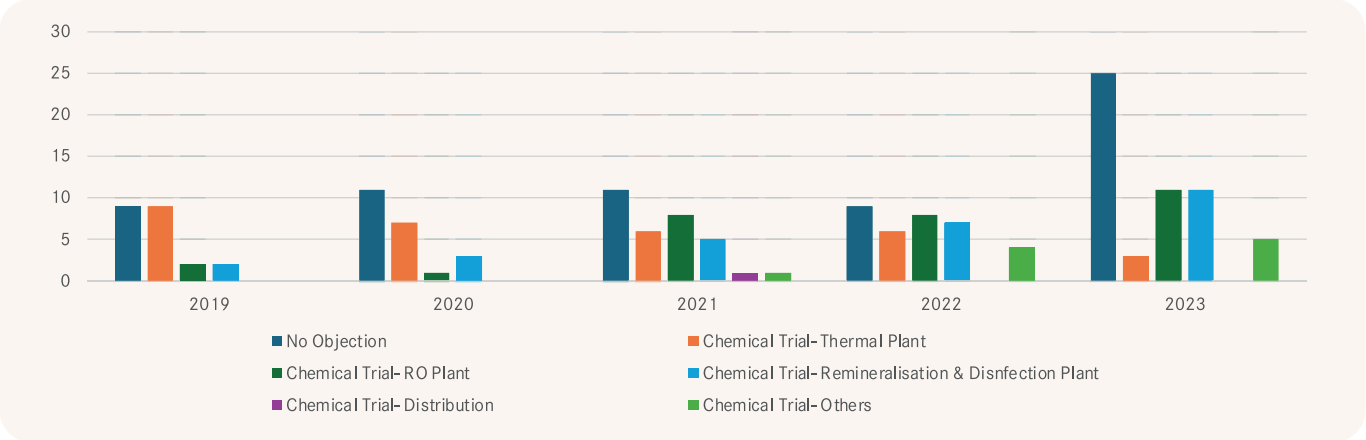


Figure 16 Five years regulatory overview of the chemicals and products that come in contact with water.

Desalination Process- Thermal and Membrane Water Production Quality Performance

Figures 17 and 18 depicts five years overview of the IWPPs desalination chlorination KPI 1 and 2. The DoE has been working with its Licensees to steadily optimise the KPIs shown below towards the optimum values.

KPI 1 has been implemented to measure and optimise the efficiency of chlorine consumption. It is an indicator of the total amount of chlorine consumed by IWPPs per unit of water produced. Chlorination system efficiency performance is used to evaluate the efficiency of the chlorination system at the desalination stage, to ensure the system will use the optimum amount of chlorine at the point of dosing to deliver the desired chlorine residual. Figure 17 demonstrates a progressive course towards the optimum target value.

KPI 1 is governed by factors such as dosing regime and process, chlorine demand of the desalinated water produced by each licensee and transmission and distribution residual chlorine requirements.

IWPPs Desalination Chlorination KPI 1 Benchmarking- Overview- (2019- 2023)

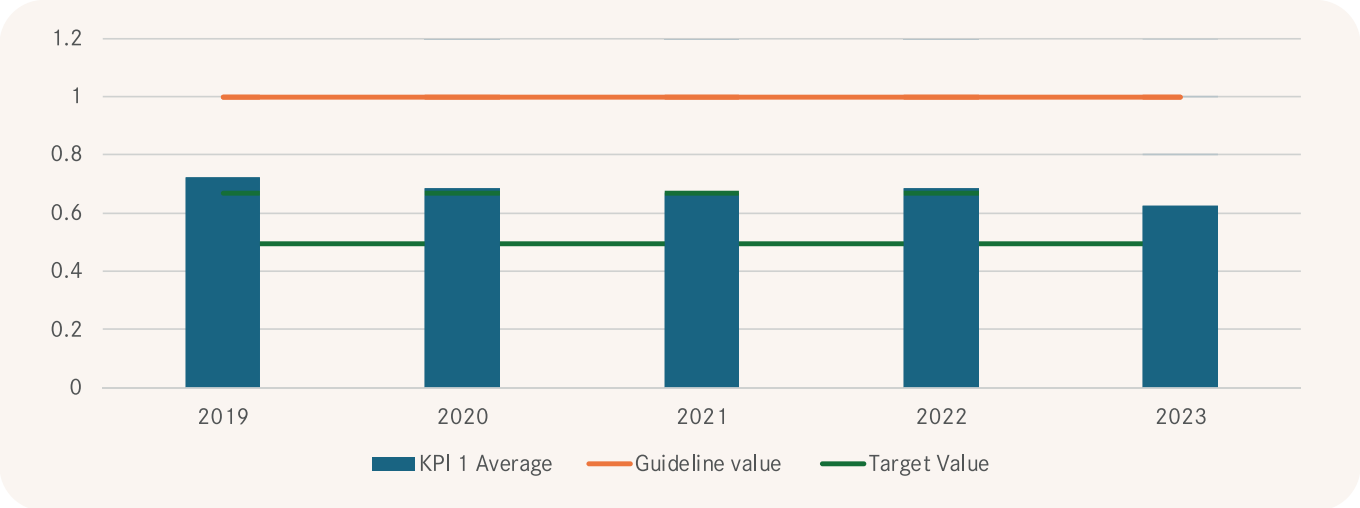


Figure 17 IWPPs Desalination Chlorination KPI -1 Overview

KPI 2 has been implemented to measure the residual chlorine regulatory compliance. KPI 2 is an indicator of the proportion of the residual chorine samples that fall outside the regulatory limit. Figure 18 demonstrates a progressive course towards the optimum target value.

KPI 2 is impacted mainly by transmission and distribution residual chlorine requirements.

IWPPs Desalination Chlorination KPI 2 Benchmarking- Overview- (2019- 2023)

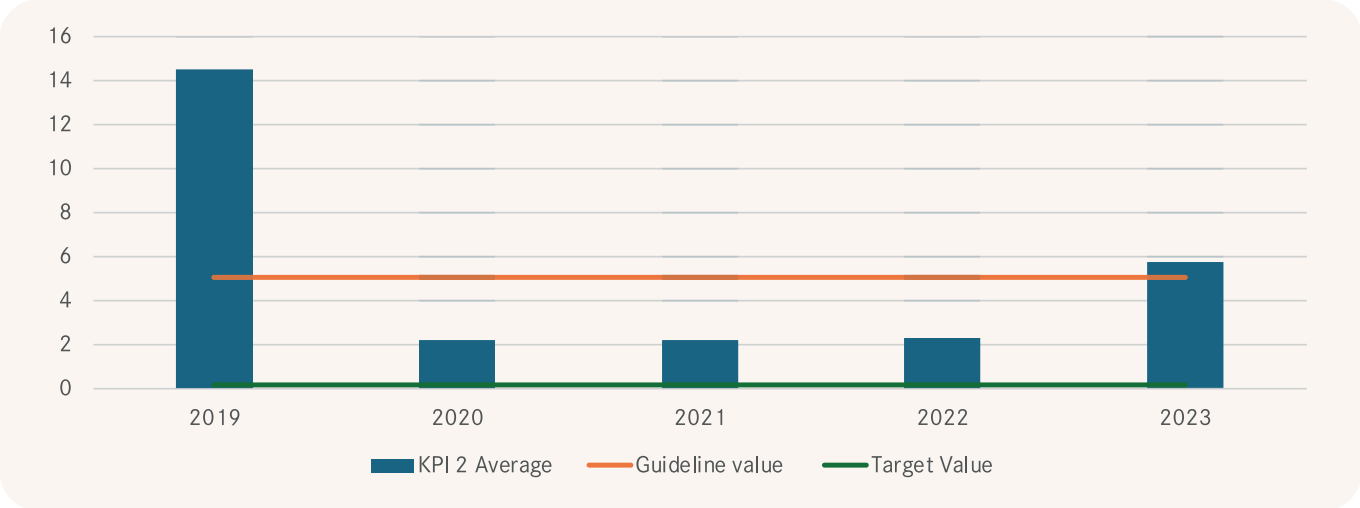


Figure 18 I(W)PPs Desalination Chlorination KPI -2 Overview

Water Quality Regulatory Implementation – Audits and Assessments

Desalination- IWPPs

To ensure compliance with the Water Quality Regulations the DoE conducts periodic audits to assess the implementation of the Licensees DWSPs. In 2023, ADDC, S1, S2, SMIPCO and TDC have been audited. The audits covered parts of the desalination (MSF, MED and RO) and distribution (piped and non-piped) networks.

The audit covers analytical arrangements such as, sampling processes, data quality and reporting. It may also include chemicals used in water treatment, Desalination, Transmission System, Distribution System (piped, non-piped and aquifers), transfer and storage processes for the supply of wholesome water.

Electricity and Water Transmission

Transmission Overview

TRANSCO operates the high voltage network (400 – 132 KV) transporting large volumes of electricity from production companies to DISCOs, high demand customers connected at the transmission system and to the northern emirates. TRANSCO is also interconnected with the 400 kV GCC interconnection.

On the water side, TRANSCO transports large volumes of water from the production companies to the distribution companies. In 2023, the 3,529 km water transmission network carried a total inlet quantity of 1,159.58 MCM (255,071 MIG), a decrease of 1.6% from 2022 which was 1,179.11 MCM (259,368 MIG), and this is mainly due to the reduction of supply to Northern Emirates. A peak of 3.55 MCMD (781.09 MIGD) of desalinated water was dispatched via mains pipelines on 31st of August 2023. These pipelines range in size from 150 to 1,600 mm in diameter and are made predominantly of cement-lined ductile iron (DI) and Carbon Steel (CS). A relatively small portion of the pipelines are of Glass Reinforced Plastic (GRP). The total despatched quantity of water by the transmission system amounted to 1,132.91 MCM (249,206 MIG).

The Tables below provide a summary of Electricity and Water Transmission Network Assets

Table 1 Electricity Transmission Network Assets

GRID SUBSTATIONS	CAPACITY	UNDERGROUND CABLES	OVERHEAD LINES
166 (220, 400 AND 132 KV)	72,095 MVA	1,259 KM	9,501 KM

Table 2 Water transmission system assets

Pipeline length	Pumping Stations	Capacity	Reservoirs	
3,529 km	48	15.63 MCMD	120	2.88 MCM
		3,439 (MIGD)		(633 MIG)

Electricity and Water Transmission

Transmission system performance is monitored through a number of Key Performance Indicators (KPIs) including:

- Transmission network unavailability
- Unsupplied energy
- Transmission system losses

Transmission Network Unavailability

System unavailability is defined as the ratio of the unavailable circuit hours and the total system circuit hours. The total unavailability remained unchanged from 2022 to 2023 at 1.2% as shown in the graph below. Analysis of the data indicates that there was a significant increase in construction related outages in 2023 compared to 2022 due to outages during the construction period of some projects.

Transmission system unavailability

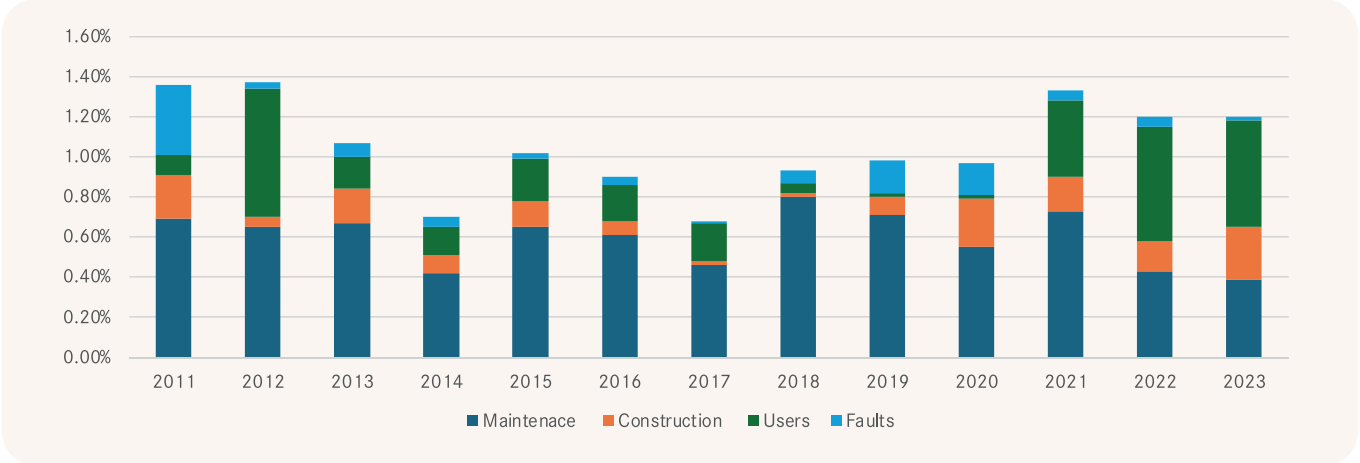


Figure 19 Transmission System Unavailability

Unsupplied Energy

The impact of loss of supply resulting from transmission incidents is quantified in terms of energy lost, also known as “unsupplied energy”, which is calculated by taking into account the size and duration of the demand lost, expressed in MWh. In 2023, there were 2 transmission incidents, which resulted in the loss of 12.99 MWh of unsupplied energy compared to 16.21 MWh in 2022 which is less than the maximum allowed 100 MWh per year.

Transmission System Incidents & Energy Lost

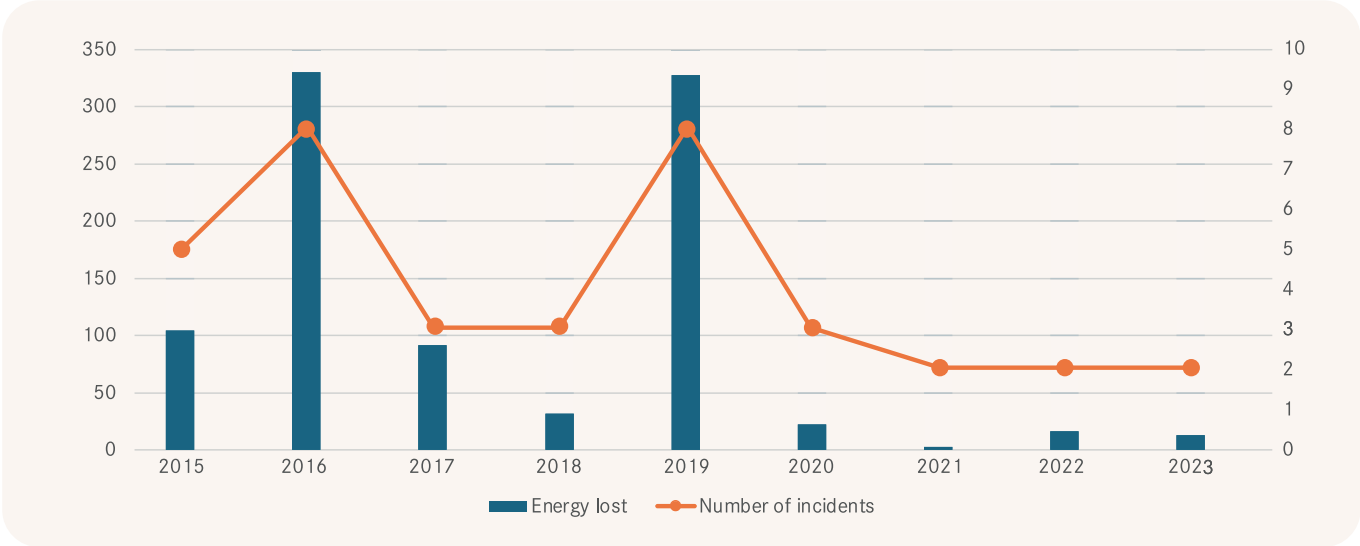


Figure 20 : Transmission System Incidents and Energy Lost (Unsupplied)

Transmission system losses

Energy loss in the transmission system is mainly due to heat dissipation as a result of electricity flow in the different parts of the network such as “overhead lines, cables and transformers”. System losses are measured as the difference between the total energy input to the transmission system and total energy output from the transmission system.

Transmission losses increased from 1.73% in 2022 to 2.04% in 2023. This is considered below the average losses for the period between 2013 and 2023. This indicator will continue to be monitored to ensure transmission system losses remain below the allowed threshold of 3%.

Transmission System Incidents & Energy Lost

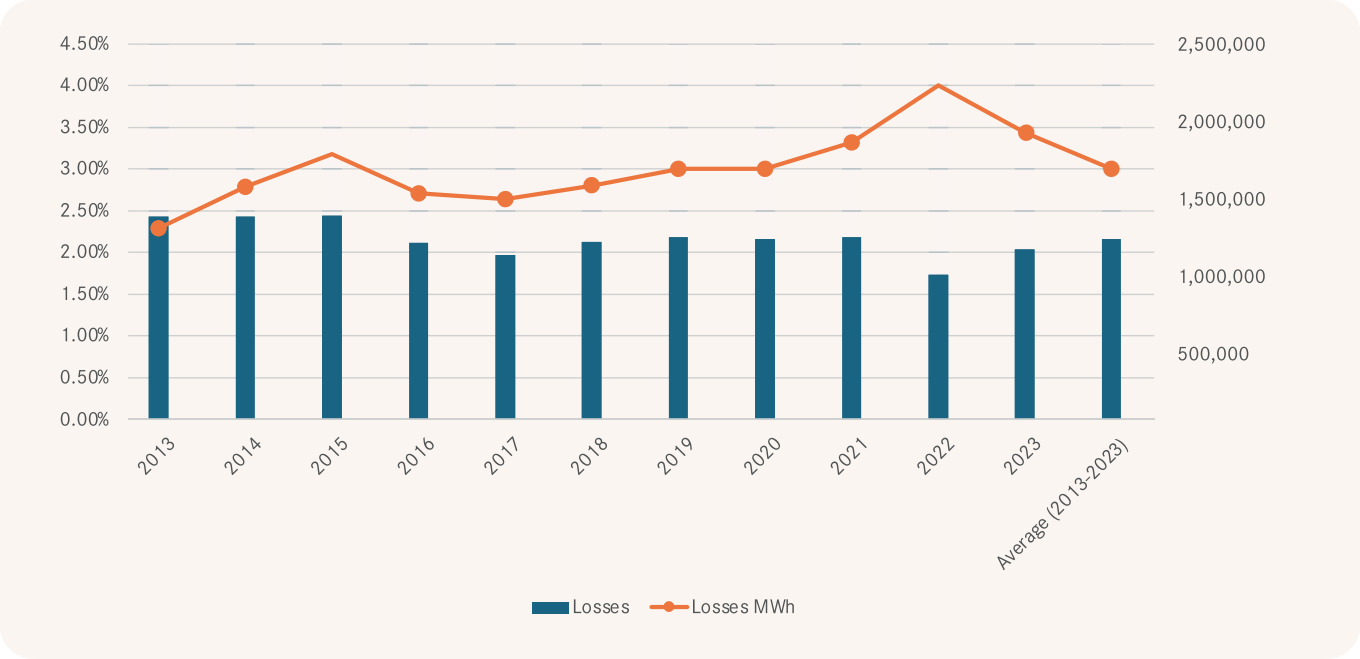


Figure 21 Transmission System Losses

Water Transmission System Performance

The performance of the water transmission system is monitored through several KPIs including:

- Water Transmission losses
- Security of supply
- System availability

Water Transmission Losses

This indicator seeks to monitor and reduce water losses, including both “real losses (physical losses) and operational losses (metering inaccuracies).

Water transmission loss is measured as the net difference between dispatched water from all producers, at the defined entry points (Transmission System Inflow) and the water dispatched to distribution at the defined exit points (Transmission System Outflow). This method also takes into consideration the change in TRANSCO’s reservoir water levels.

Figure 22 shows that the percentage of water transmission losses remained below the 2% tolerance threshold from 2011 to 2023. Compared to 2022, the percentage has increased from 1.8 % to 2.34%. TRANSCO is working closely with DoE to maintain transmission losses below the 2% threshold.

Water Transmission Loss (%)

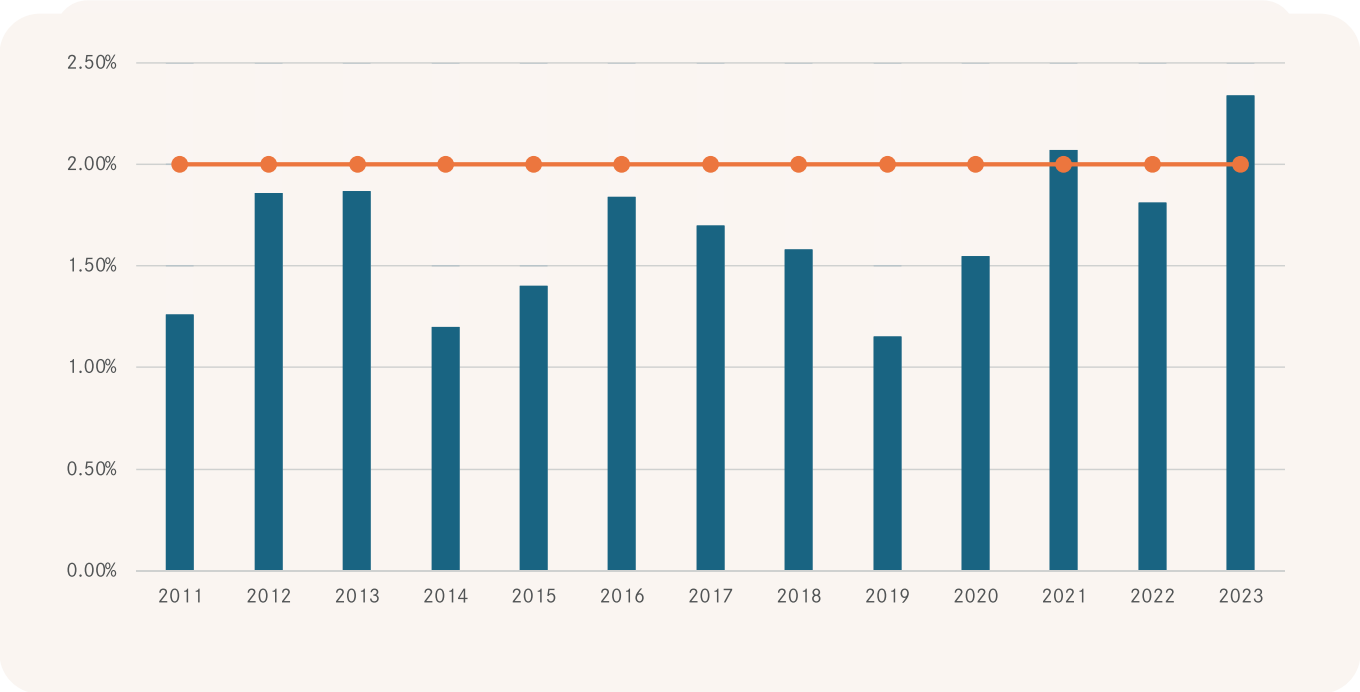


Figure 22: Water Transmission Loss (%)

Security of Supply

The security of supply indicator investigates any supply shortfalls in meeting the scheduled water quantities. This indicator measure's reliability and efficiency, as well as flexibility in reacting to unforeseen demand events. It measures TRANSCO's system ability to cope with unexpected situations that can impact water supply. Scheduled water demands by the distribution companies may not be fully met by TRANSCO due to 2 main reasons:

1. Unpredictable demand events.
2. Supply interruptions

Unpredictable demand events

This happens when DISCO's actual demand deviated from the scheduled quantity by a certain threshold. This deviation could be attributed to DISCO's forecasting errors, non-availability of metering data at some data management platforms (DMPs), or insufficient consumption profiling.

Figures 23 and 24 below show the unpredictable demand events for both ADDC and AADC, respectively, from 2010 to 2023. There are inherent difficulties in generating highly accurate demand forecasts, which require further progress with data collection and validation, as well as network operational management. Compared to 2022, the number of unpredicted demands increased from 2,257 events to 4,095 during 2023. DISCOs need to reevaluate next day forecast on each zonal area to reduce the number of unpredicted demands

ADDC Unpredictable demand events

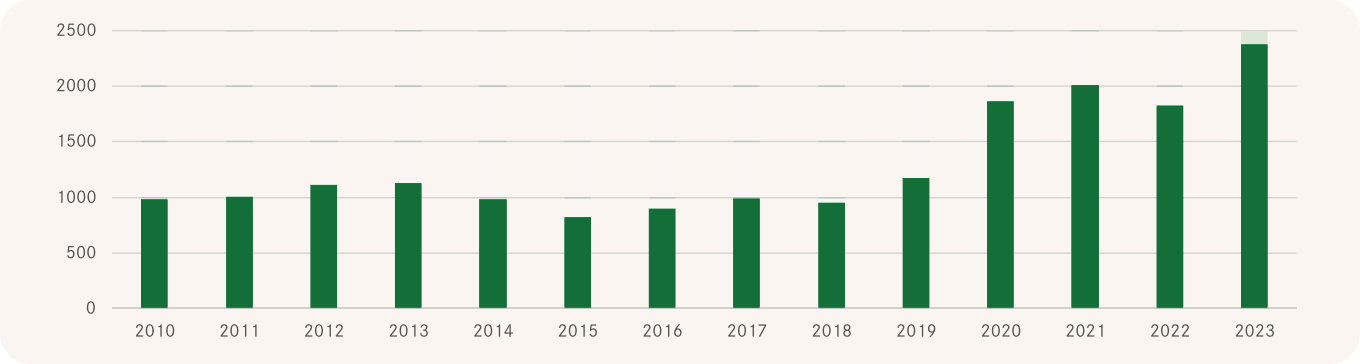


Figure23: ADDC Unpredictable Demand Events

AADC Unpredictable demand events

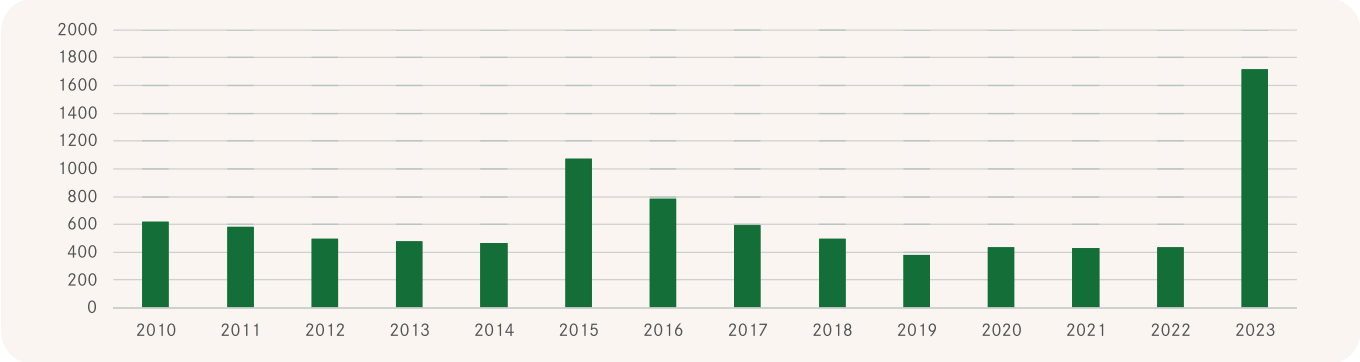


Figure 24: AADC Unpredictable Demand Events

Supply interruptions

Supply interruptions can occur from incidents or constraints within the production; transmission; or distribution system. Figure 25 below shows the unsupplied quantities and interruptions caused by TRANSCO from 2010 to 2023. In 2018 an increase was observed again primarily due to operational challenges resulting from the shutdown of some pumping stations. The DoE continues to work closely with TRANSCO to enhance their operations to minimize such events and reduce the unsupplied quantities. In 2021 and 2022, the figures of both unsupplied quantities and number of interruptions are mostly stable where a very slight change can be seen from Figure 25. In 2023, there was an increase in quantity of unsupplied water compared to 2022. DoE continues to monitor such indicators to ensure corrective actions are implemented.

The total water transmitted to AADC and ADDC is 1056.75 MCM (232,453.49 MIG) and the unsupplied quantity caused by TRANSCO due to interruption is 0.0824 MCM (18.13 MIG) which resulted 0.0078% for 2023 water security of supply. This is less than 0.05% which is the water security of supply KPI.

Unsupplied quantities vs. interruptions

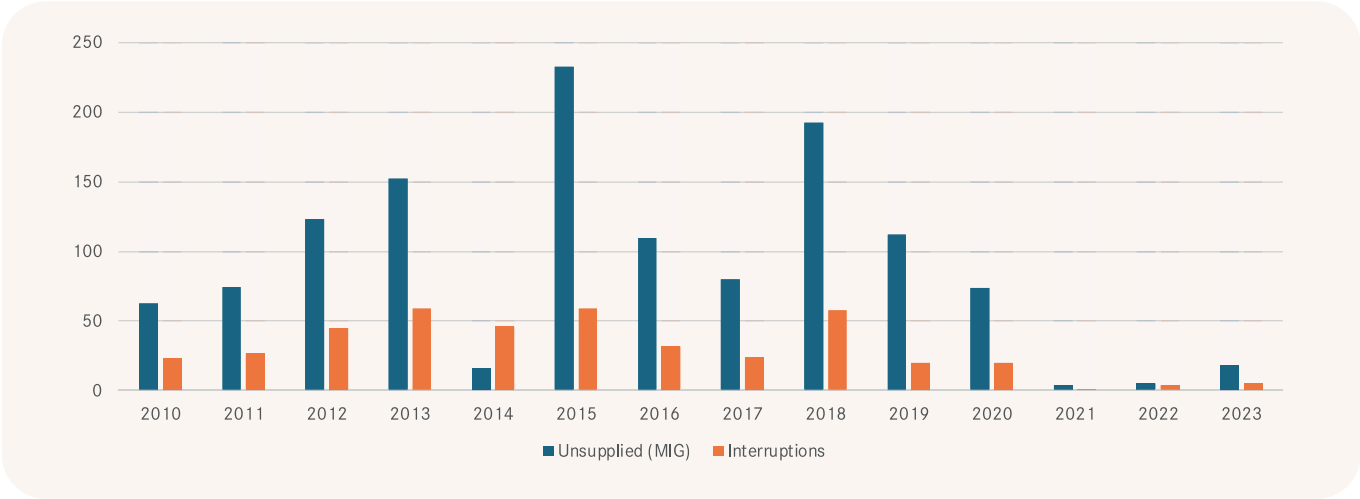


Figure 25: Unsupplied Quantities vs. Interruptions

System availability

This indicator determines the main transmission system components/assets (pumps, transmission lines, storage tanks, or combination thereof) that are either operational or in standby mode. Components that do not meet this definition are classed as “unavailable”.

Transmission System Availability has remained relatively steady and positive since 2010; TRANSCO’s overall system availability in 2023 is 97.78%, as illustrated in Figure 26 below. Water availability performance for 2023 is (97.78%) which shows almost a stable performance compared to 2022 and still maintaining its position above the regulatory target of 95%.

Transmission System Availability

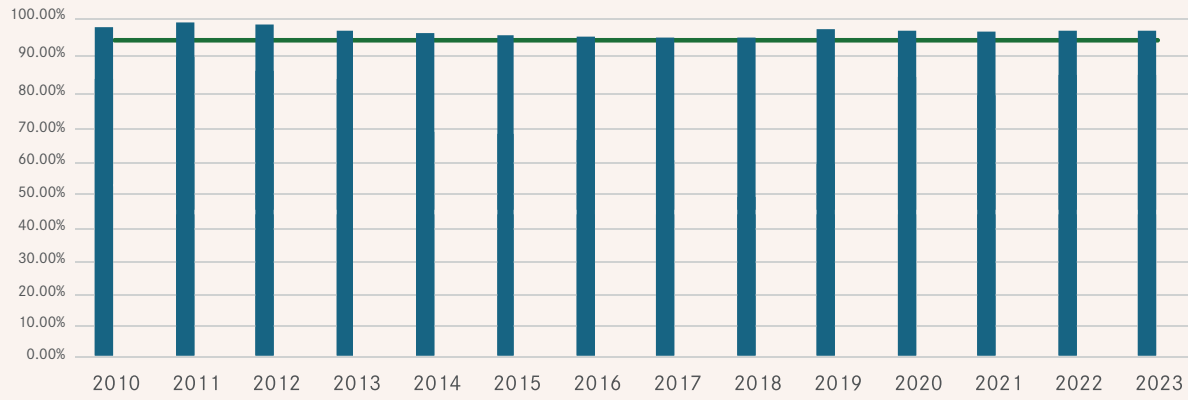


Figure 26: Transmission System Availability

Water Quality Regulatory Performance - Transmission

TRANSCO

The transmission water quality sampling and testing is conducted as per the WQR regulatory prerequisites. The sample must be representative of the water quality at the time of sampling, its collection program is made with sampling frequency from predetermined locations at equal intervals over the year and it must be analysed as soon as practicable after it has been taken.

The total number of tests completed by TRANSCO in 2023 was 45,389 with 62 water quality parameters tested in TRANSCO transmission network. The overall water quality testing frequency compliance (measure of the number of tests conducted against those required) for TRANSCO was 96.05%.

The overall water quality compliance for 2023 was 96.75%, with Physical Parameters and Microbial Parameters compliance at 92.48% and 98.91% respectively.

The figure below depicts five years overview of the transmission consistent overall water quality compliance.

TRANSCO Water Quality Regulatory Compliance Benchmarking %- Overview- (2019- 2023)

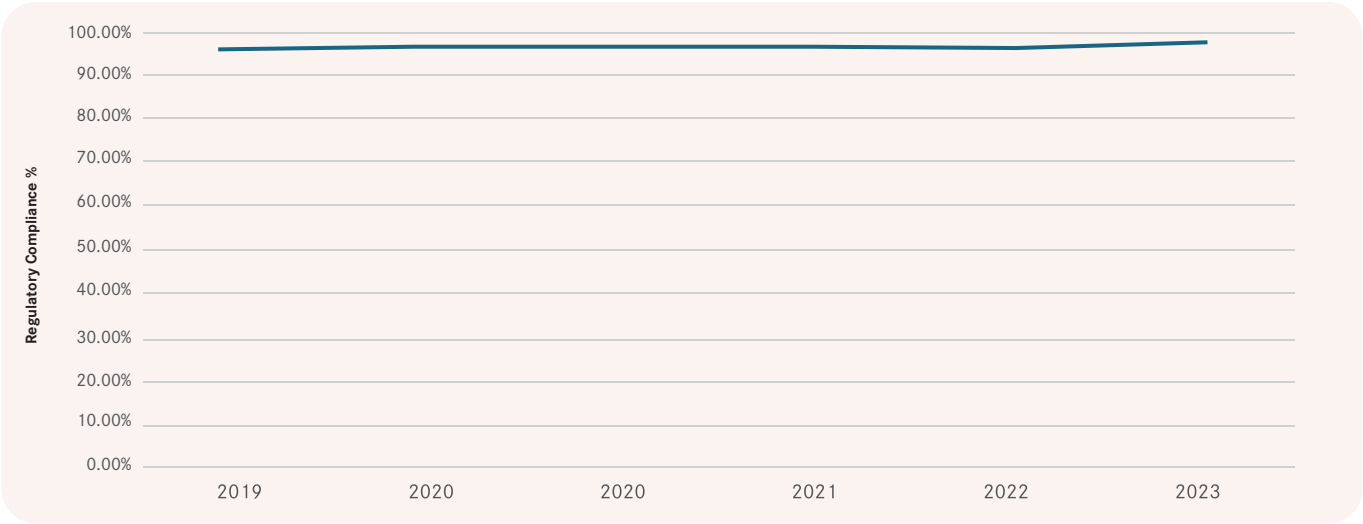


Figure 27: TRANSCO Water Quality Regulatory Compliance- %

Electricity and Water Distribution

Distribution Overview

ADDC and AADC own and operate electricity and water distribution and supply networks in their respective geographical areas. Both companies own and operate the low voltage electricity network (33 - 22- 11 KV), as well as a water distribution network with a total length of 14,146 (km) transporting water from the transmission system to homes and businesses across the Emirate of Abu Dhabi.

The tables below provide an overview of the electricity and water distribution customers and asset base in 2023.

Table 3: Number of Customers

	ADDC	AADC	Total
Number of Electricity customers	435,296	163,241	**598,537**
Number of Water customers	366,090	102,477	**468,567**

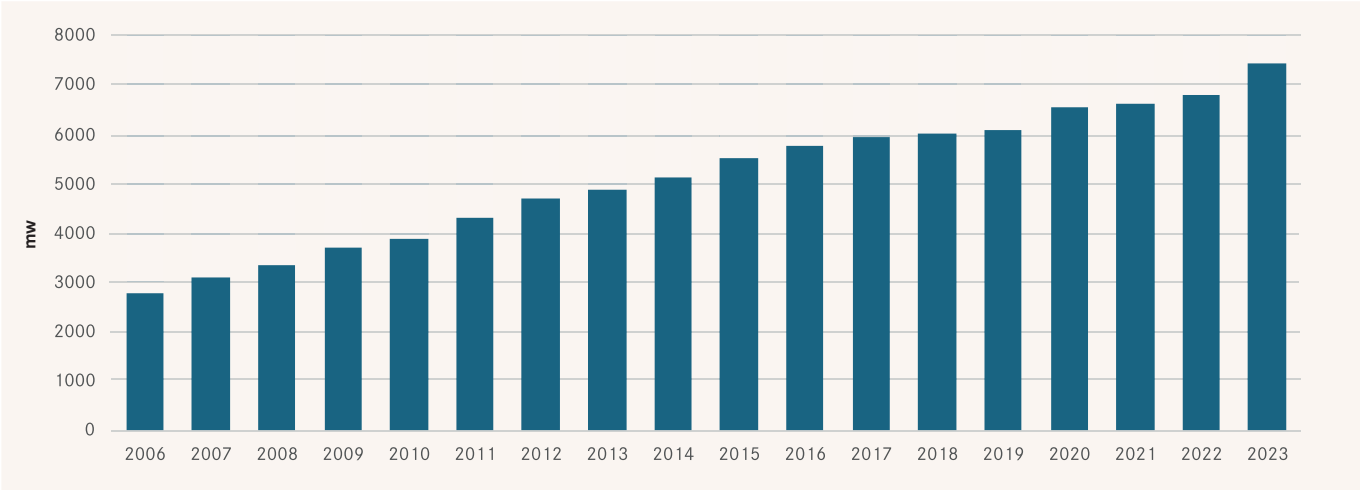
Table 4: Electricity and Water distribution network assets

	ADDC	AADC	Total
Electricity Distribution Network Assets			
Number of Primary Substations	325	181	**506**
Number of Distribution Substations	22,216	17,412	**36,628**
km of cable/overhead lines	51,034	30,525	**81,559**
Water Distribution Network Assets			
Water Pipelines (km)	9,611.68	5,205.33	**14,817**
Pumping Stations	27	06	**33**
Capacity	0.198 MCMD (43.68 MIGD)	0.23 MCMD (47.20 MIGD)	**0.43 MCMD (90.88 MIGD)**
Reservoirs	43	12	**55**
Capacity	0.12 MCM (26.85 MIG)	0.11 MCM (25.5 MIG)	**0.23 MCM (52.35 MIGD)**

Electricity Peak Demand

The peak demand load of ADDC grew by 9.1% from 2022 to reach 7,431 MW in 2023, while that of AADC grew by 5.8% to reach 2,744 MW. The figures below show the peak demand growth for the last 18 years for each of the Distribution Companies.

ADDC Peak Demand Load



AADC Peak Demand Load

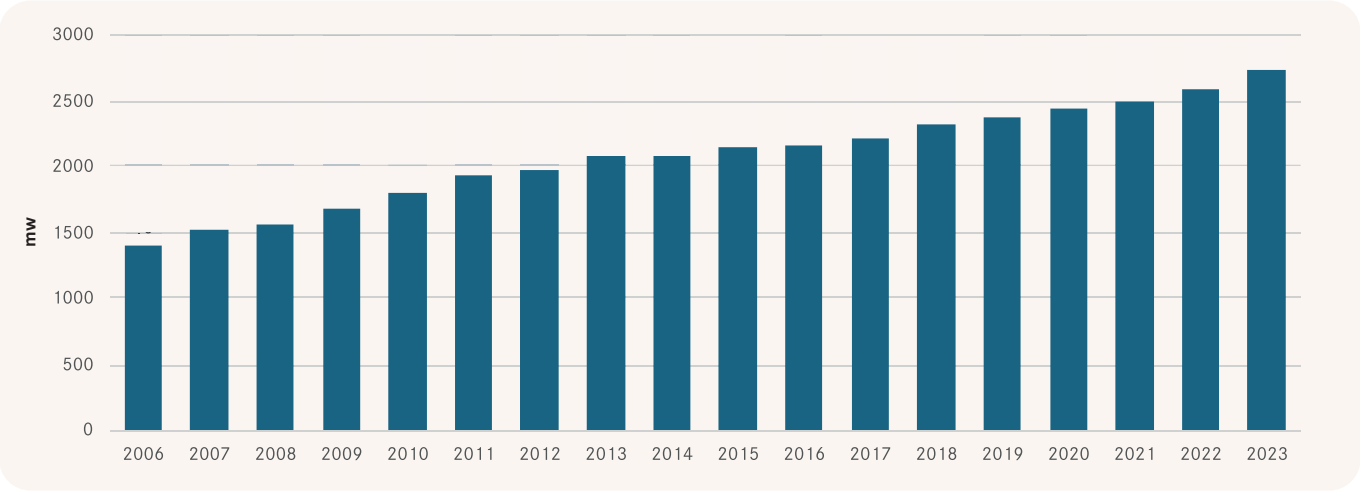


Figure 28 : Peak demand growth

In 2023, the average daily water supplied by TRANSCO to Abu Dhabi was 2.15 MCMD (473 MIGD) and to Al Ain was 0.74 MCMD (163 MIGD), based on weekly averages, as illustrated in the graphs below. This has been consistent with the trend of the weekly water supplied in 2022.

Water supply - Abu Dhabi Emirate

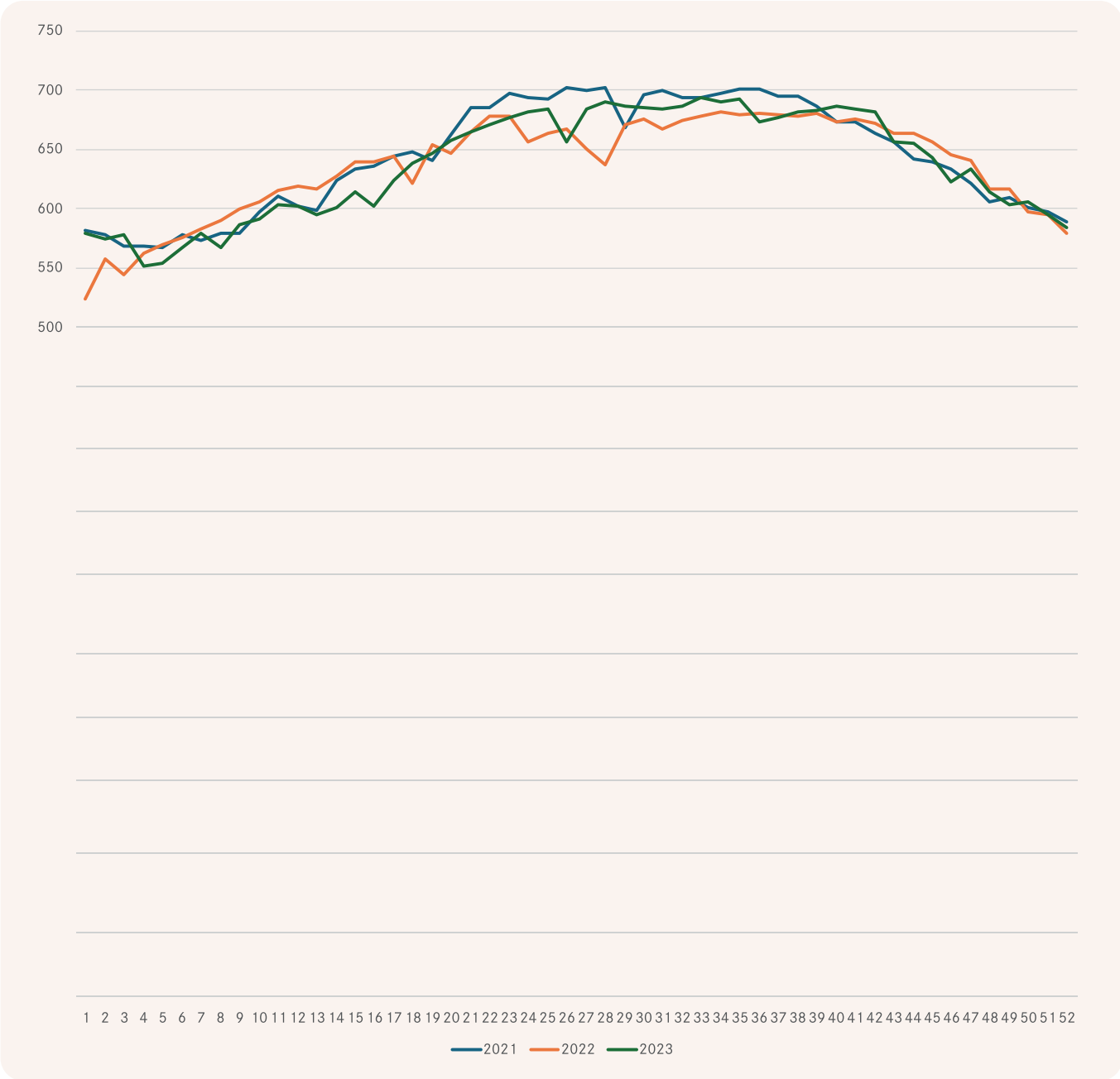


Figure 29: Water supply – Abu Dhabi Emirate

Electricity Distribution Network Performance
Similar to the transmission system, the performance of the distribution system in terms of efficiency and quality is monitored through KPIs measuring parameters such as customer interruptions and system losses.

Customer Interruptions

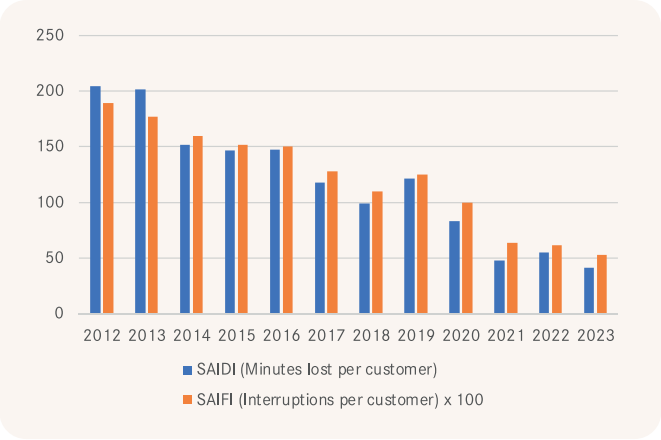
SAIDI, the System Average Interruption Duration Index is calculated as the sum of customer minutes lost experienced during the year due to interruptions in the network divided by the number of customers. It gives an indication of the average duration of interruption experienced by a customer over the year.

SAIFI, the System Average Interruption Frequency Index is calculated as the sum of the number of customers affected by interruptions during the year divided by the number of customers. It gives an indication of the average number of interruptions experienced by a customer over the year.

While these two KPIs measure averages over the year, any major interruptions, which have a large contribution to SAIDI and SAIFI, are reportable under the Incident Reporting Regulations and investigated accordingly. These incidents, and reporting requirements, are elaborated in Chapter 5 of this report.

Both SAIDI and SAIFI significantly improved in ADDC by 24.6% and 13.7% respectively thanks to fewer failures in the power network and the recovery from COVID-19 which caused delays in preventative maintenance that was, for the most part, completed in 2022.
AADC also saw improvement in SAIDI and SAIFI in 2023 by 5.8% and 6.6% respectively.

ADDC Power interruption



ADDC Power interruption

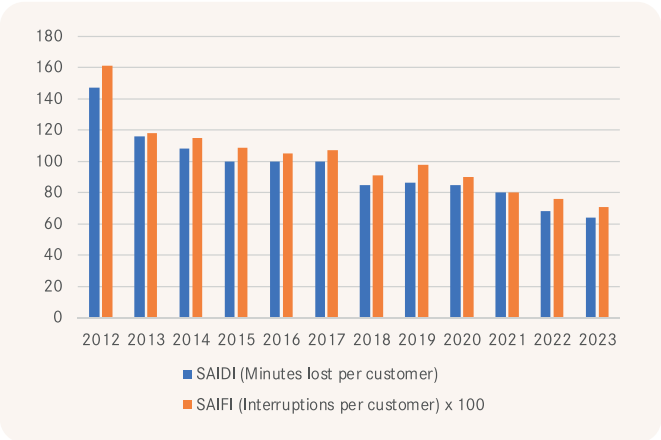


Figure 30 ADDC and AADC Power Interruptions

In 2022 the Council of European Energy Regulators (CEER) conducted a benchmarking study and published a report on the quality of supply for 2018 of its members, and SAIDI and SAIFI were the main indices used for electricity. Similar to its ranking based on the previous study, it is apparent that Abu Dhabi emirate overall still fairs reasonably well in comparison with the top-ranking European countries and its ranking has improved considerably in the last 5 years. This is due to the continuous efforts of the DISCOs over the years to improve the performance of the network in terms of capital investment and operational practices.

Losses

Electricity losses are measured by the difference between the units entering the system and those leaving it. In the case of distribution, the measurement is distorted by the billing and meter-reading cycle of both AADC/ADDC customers and therefore show significant year-on-year variations.
A substantial decrease in losses can be seen in 2023 for AADC and ADDC due the gradual recovery from the COVID-19 pandemic that caused an increase in losses from 2020 onwards. The average losses are now comparable with pre-pandemic losses and shows variations within acceptable margins.

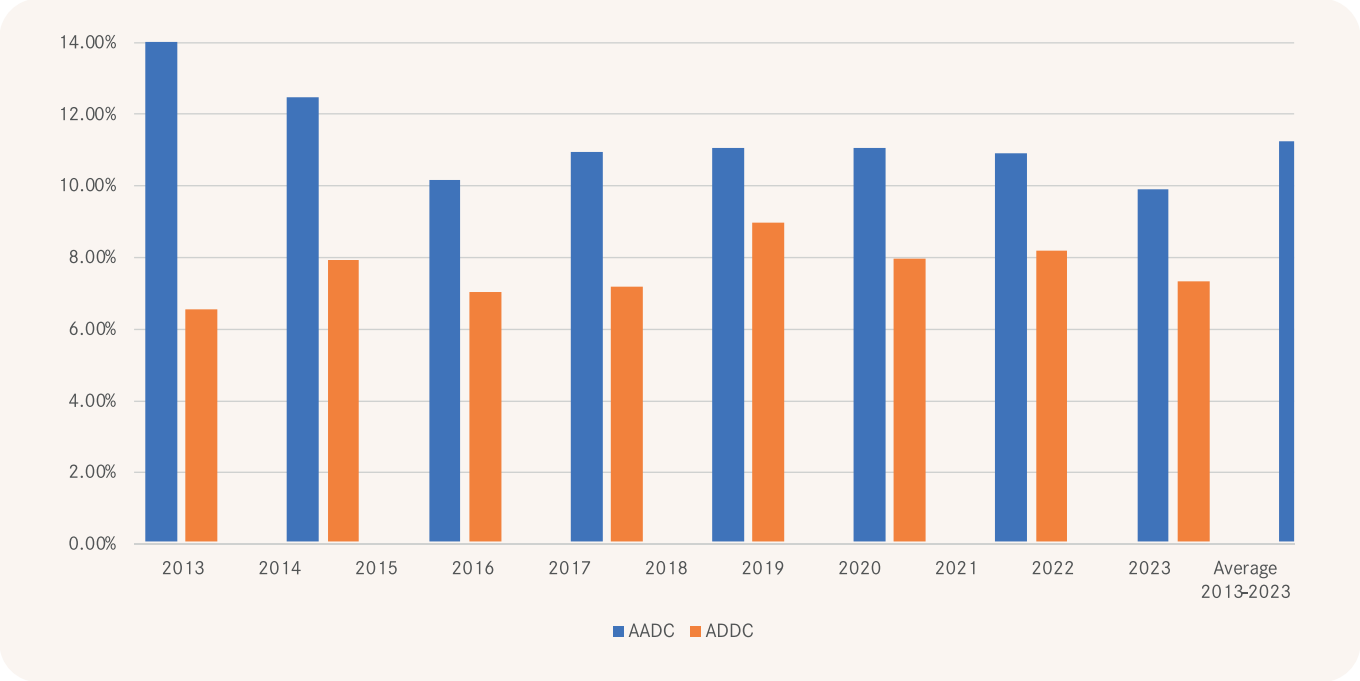


Figure 31 Distribution Losses

Water Distribution System Performance
Similarly, the performance of the water distribution system is measured using various indicators developed by the DoE, including:

- Pressure of Supply
- Type of supply

Pressure of Supply
Pressure of Supply measures supply pressure with a view to achieving a standardized level sufficient to supply low-rise buildings, thereby reducing reliance on ground storage tanks and preventing infiltration by ground water contaminants.

In line with the Water Supply Regulations the minimum required pressure in the distribution network is 1.25 bar. In 2023, compliance with this requirement is stable around 97.80% in Abu Dhabi, and increased to 92.85% in Al Ain, as shown in Figures 32 and 33 below. These percentages are calculated as the ratio of number of areas that recorded an average pressure lower than the regulatory requirement of 1.25 bar to the total number of areas categorized under Water Pumping Zones.

With respect to ADDC, all the noncompliant cases were in the Eastern Region in remote areas of Moazes and Al Adla. The relatively good results have been achieved through pumping optimization in the transmission system and re-adjustment of control valves to optimize pressure distribution within the distribution network.

Pressure of Supply ADDC

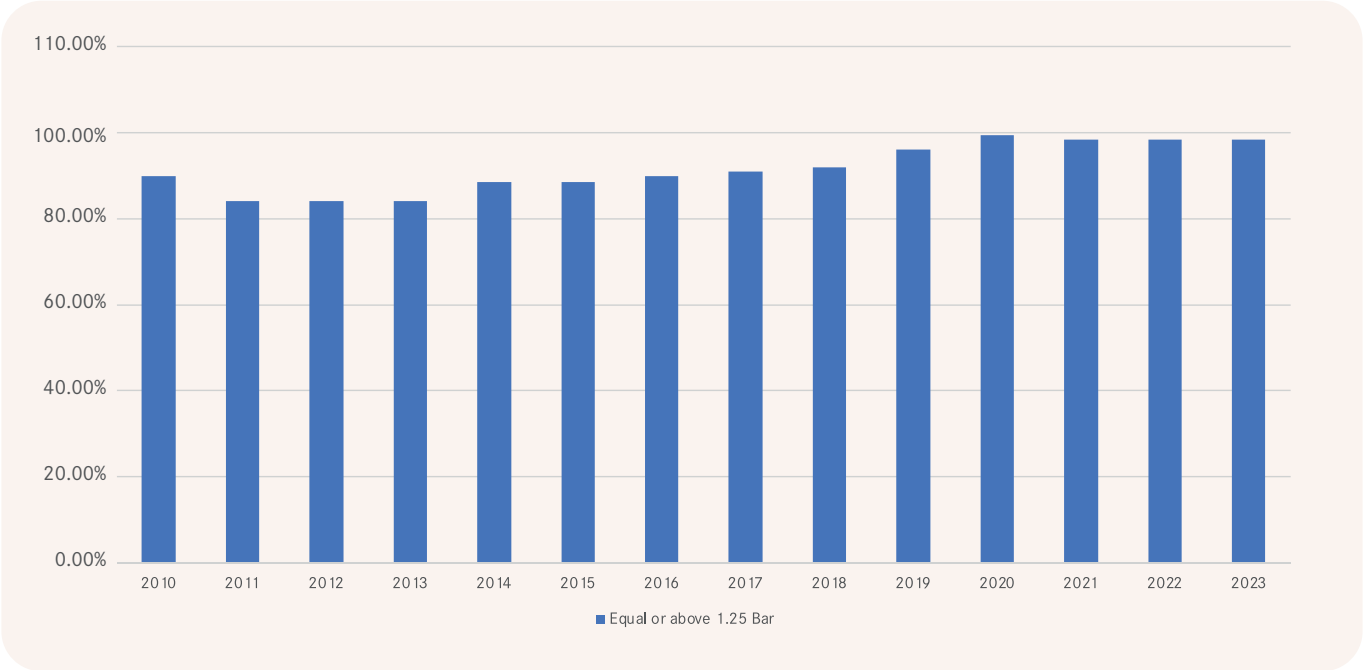


Figure 32: Pressure of Supply ADDC

With respect to AADC, the noncompliant cases were in Abu Samra,) and Alkhabisi due to the pressure management/reduction required there, to avoid breakages on the aged networks. The number of non-compliant zones has decreased by 1. This was possible after the completion of a rehabilitation project to completely replace the old water network at Al Aamirah area and subsequent management/improvement of the water network pressure.

Pressure of Supply AADC

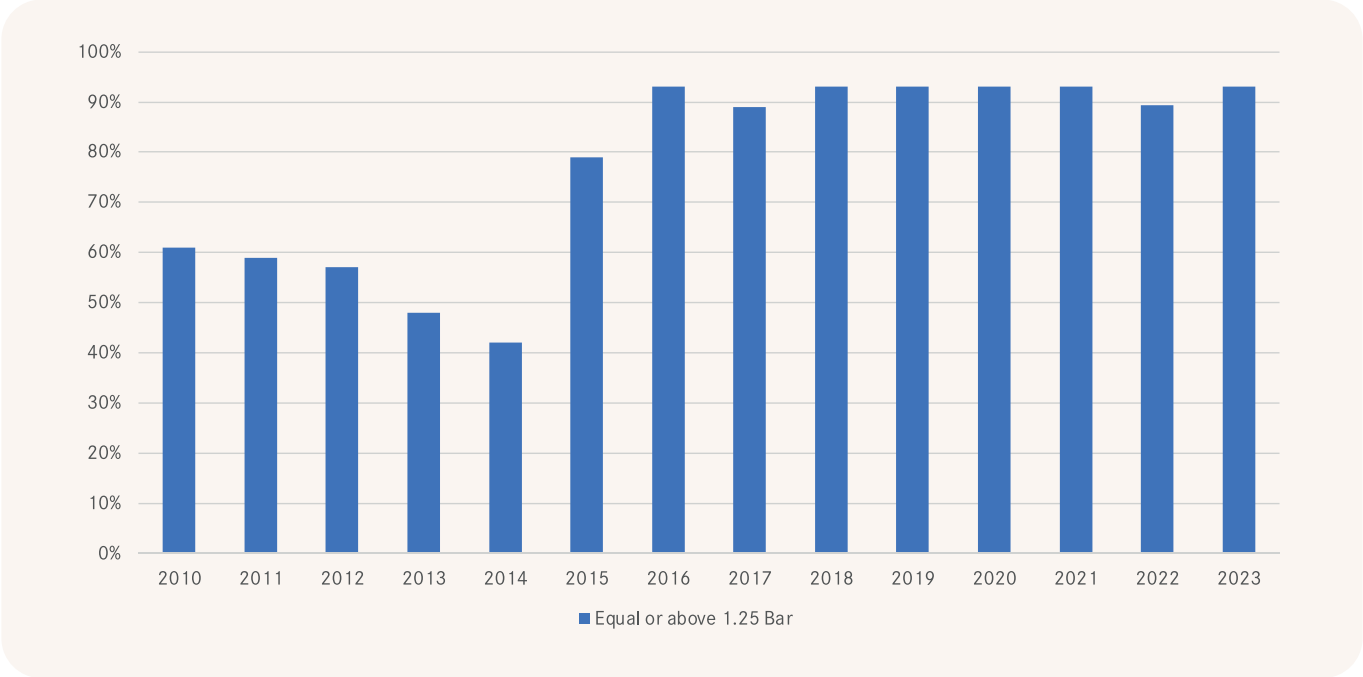


Figure 33: Pressure of Supply AADC

Type of Supply

This indicator measures the progress made towards reducing the number of customers dependent on tankers and intermittent supply.

For ADDC the proportion of customers connected to the network stands at 98.91% with 100% on continuous supply, while the remaining customers (1.09%) are supplied with water by tankers. Tanker supplies are for the customers who are far from the existing network or residing within a new network which is not in operation due to the under occupancy of the area.

The situation in AADC has been steadily improving and around 99.7% of AADC's customers are now connected to the network with 97.66% on continuous supply and only 2.02% on intermittent supply, like last year. The remaining customers (0.32%) are supplied with water by tankers.

The Figure 34 below shows the increase in unrestricted supply in Al Ain during 2023.

Unrestricted Supply in AADC

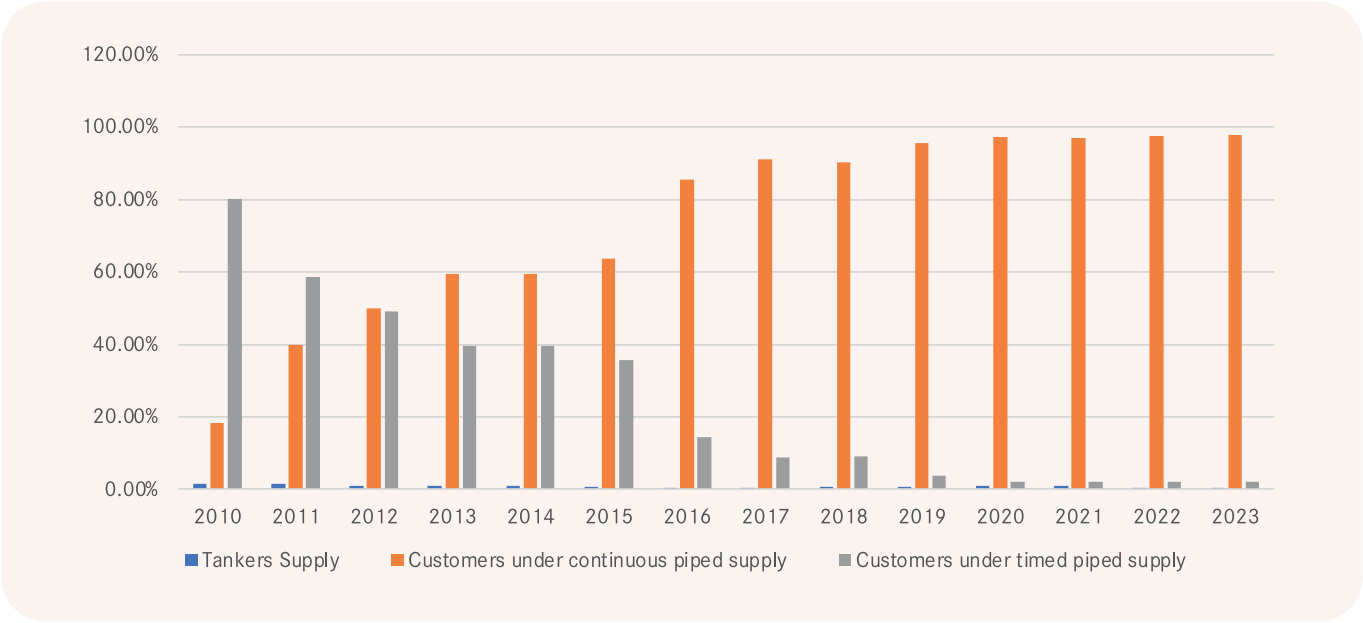


Figure 34: Unrestricted Supply in AADC

Water Quality Regulatory Performance - Distribution

The distribution water quality sampling and testing is conducted as per the WQR regulatory prerequisites. The sample must be representative of the water quality at the time of sampling, its collection program is made with sampling frequency from predetermined locations at equal intervals over the year and it must be analysed as soon as practicable after it has been taken.

Distribution- ADDC

The total number of tests completed by ADDC in 2023 was 41,748, with 64 water quality parameters examined for the ADDC distribution network. The overall water quality testing frequency compliance (measure of the number of tests conducted against those required) for ADDC was 99.8%.

The overall water quality compliance for 2023 was 97.52%, with Physical Parameters and Microbial Parameters compliance at 97.43% and 100% respectively.
The figure below depicts five years overview of ADDC consistent overall water quality compliance.

ADDC Water Quality Regulatory Compliance Benchmarking %- Overview- (2019-2023)

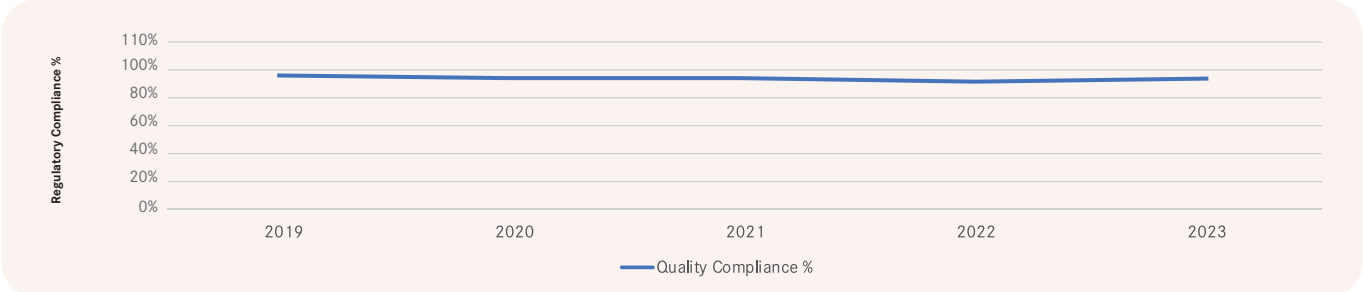


Figure 35: ADDC Water Quality Regulatory Compliance

Distribution- AADC

The total number of tests completed by AADC in 2023 was 14,769, with 64 water quality parameters examined for the AADC distribution network. The overall water quality testing frequency compliance (measure of the number of tests conducted against those required) for AADC was 100%.

The overall water quality compliance for 2023 was 98.57%, with Physical Parameters and Microbial Parameters compliance at 99.7% and 100% respectively.

The figure below depicts five years overview of AADC consistent overall water quality compliance.

AADC Water Quality Regulatory Compliance Benchmarking %- Overview- (2019-2023)

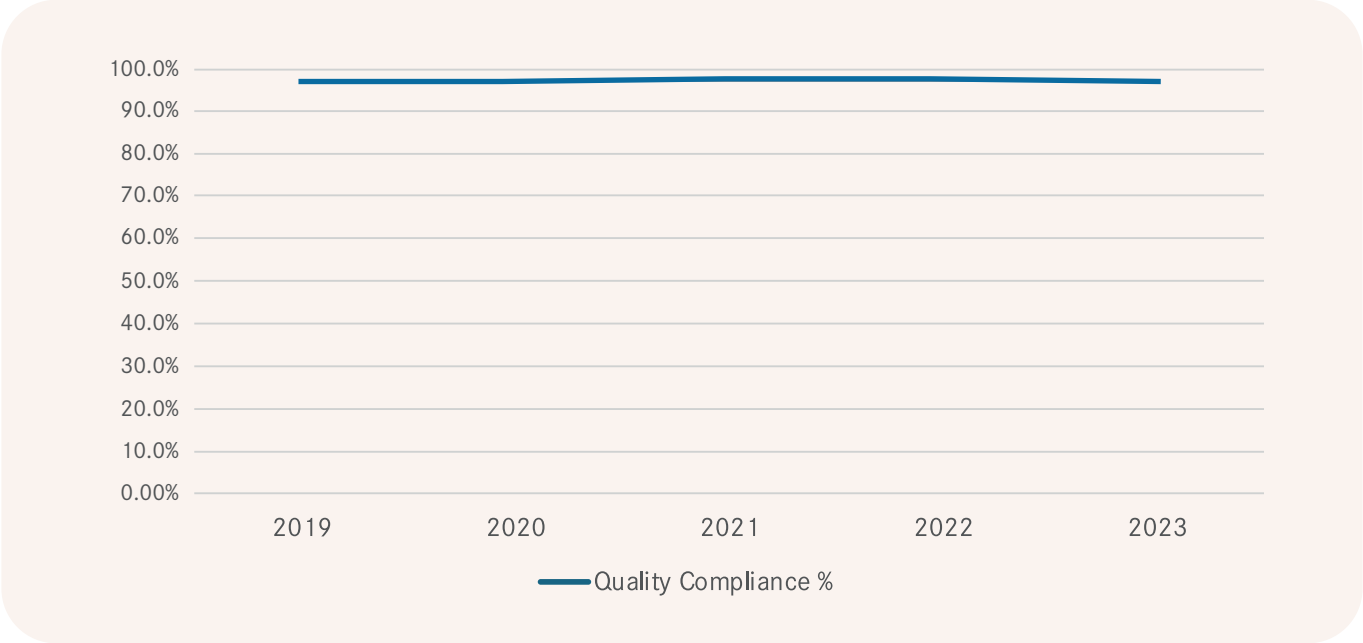


Figure 36: AADC Water Quality Regulatory Compliance- %

6. Wastewater and Recycled Water

Collection

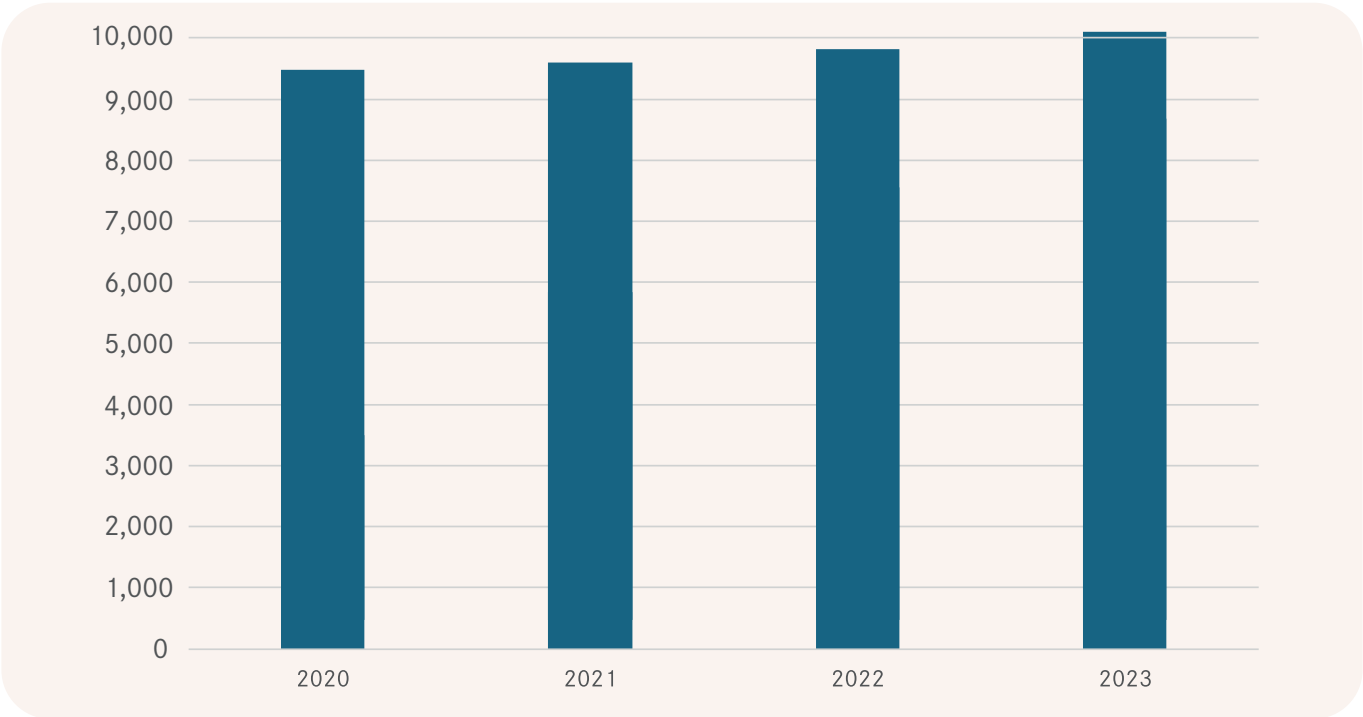
Wastewater collection is defined as the connection of premises to the sewerage system and the transportation of wastewater from premises or customers to the wastewater treatment system. The key components of the collection systems operated in the Emirate are:

- Deep tunnel sewer;
- Conventional gravity sewers;
- Pumping stations; and
- Pumping mains.

The Strategic Tunnel Enhancement Programme (STEP) project in 2017 enabled ADSWS to use link sewers to intercept the wastewater flows in existing gravity sewers just upstream of the existing pumping stations and transfer these flows into the Deep tunnel sewer. The wastewater is then conveyed by gravity via the Deep tunnel sewer to the Al Wathba 1 and Al Wathba 2 treatment plants.

Currently, flows from catchments of main pumping stations in Abu Dhabi MPS1, MPS2, MPS3, MPS4, MPS13, MPS14, MPS6, MPS17, MPS8N and many smaller pumping stations are diverted to the Deep tunnel. Several asset enhancement and link sewer projects continued in 2023 with further enhancement projects planned through to 2026.

Network Length



In 2023 ADSWS operated a total of 260 pumping stations which ranged in size from small local stations to large terminal pumping stations rated at over 300l/s. Additionally, the total network length operated by ADSWS in 2023 was 10,020 km. Figure 37 illustrates the year-on-year change in the length of sewer network operated by ADSWS.

The network length has increased steadily since 2018 due to new network projects and networks adoption from developers.

Collection Network Performance
ADSWS's sewerage collection network is monitored by several KPIs set by the DoE, including:
Sewer collapses per 100km

A sewer collapse is a break or collapse in any gravity sewer, pumping main or vacuum system main which forms part of the licensee's sewerage system and causes an interruption to the service.

The number of collapses per 100km of sewer is a good indicator of the effectiveness of collection system asset management activities and the performance of the operator in managing third party activities close to sewer systems.
Sewer blockages per 100km

A sewer blockage is any partial or total blockage in any gravity sewer, pumping main or vacuum system main which forms part of the licensee's sewerage system and causes an interruption to the service.
The frequency of blockages per 100km is a good indicator of the effectiveness of operation and maintenance activities in the collection system.

Figure 38 shows ADSSC's sewer collapses and blockages rate between 2019 and 2023.

Sewer Collapses & Blockages per 100km

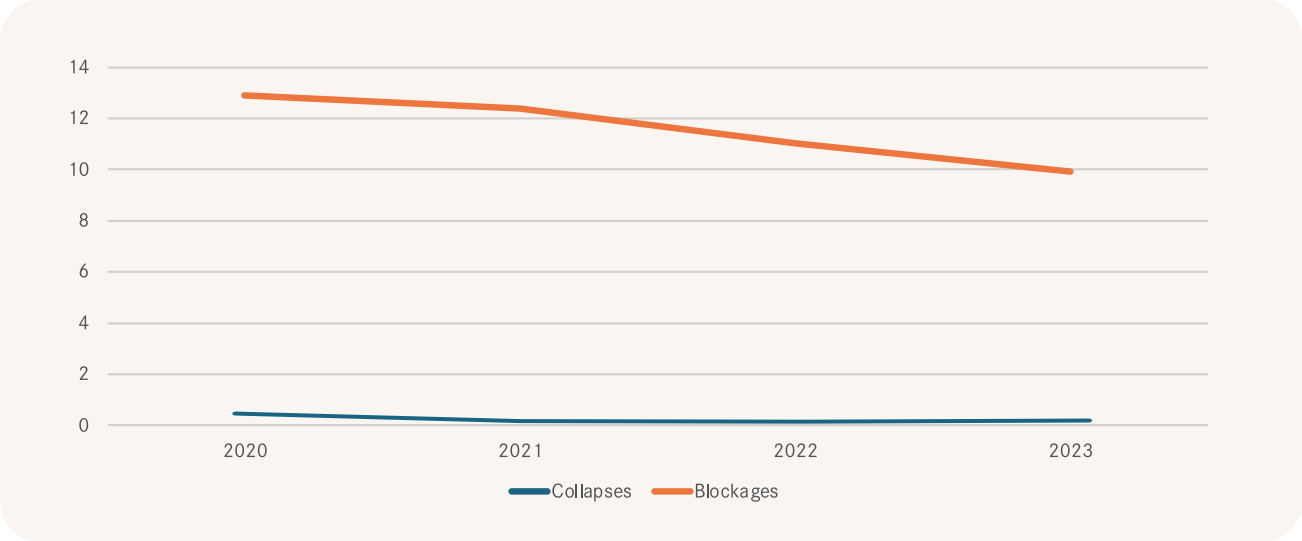


Figure 38: Sewer collapses & blockages per 100km

The primary contributor to the blockages was reported to be the fibre optic cables installed in the sewer system in Abu Dhabi City. Additionally, ADSWS continued their network maintenance activities to further reduce the number of public blockages.

It should be noted that the above numbers do not include data on the blockages cleared from private sewer systems which totalled a further 81,634 incidents in 2023.

The rate of sewer collapses demonstrated steady trend from 2022 to 2023.

Quality Performance
Trade Effluent Control

The discharge of Trade Effluent poses a significant operational challenge to wastewater collection, treatment, and disposal systems. In order to manage these risks, ADSWS is empowered to issue and enforce consents that define the terms and conditions under which the discharge can be made.

There were a number of new consents issued or terminated by ADSWS in 2023, At the close of 2023 there were 96 consented entities due to consenting the District Cooling facilities. Figure 39 illustrates the change in number of consented entities between 2015 and 2023.

Number of Consented Entities

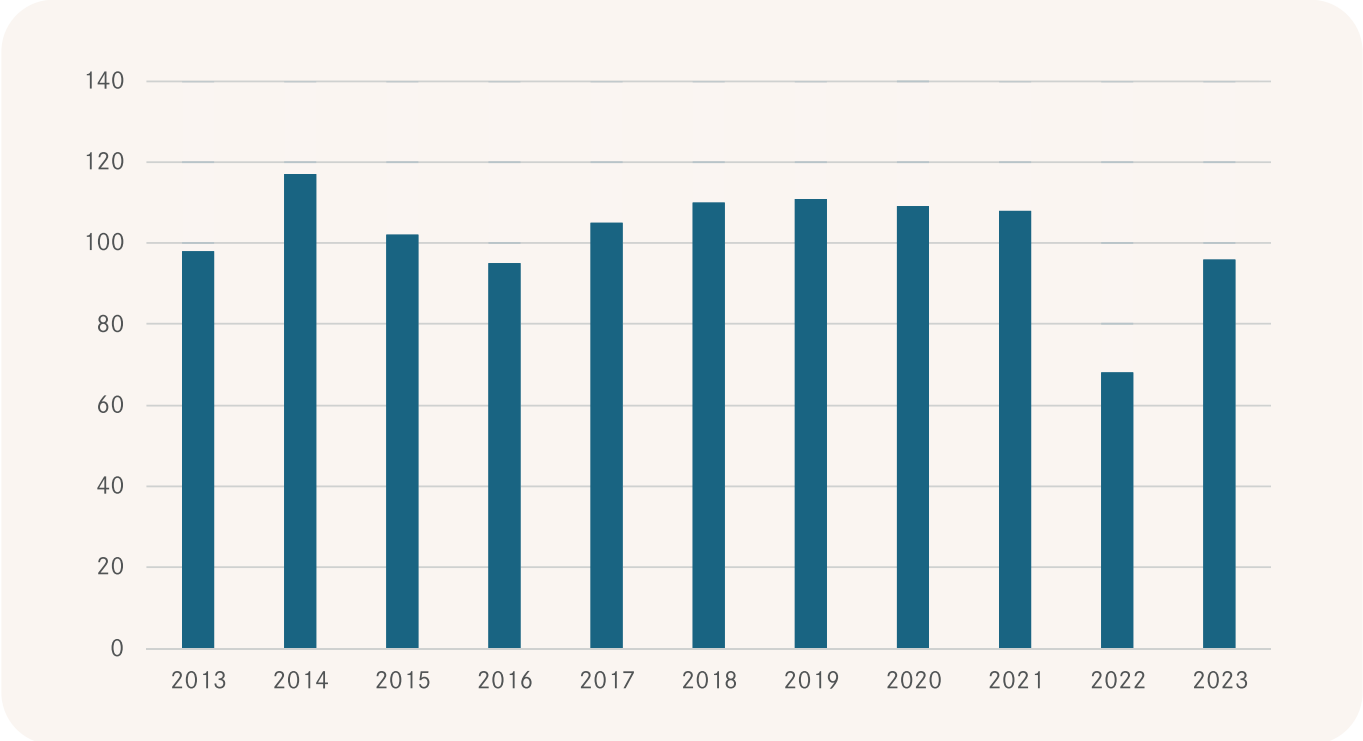


Figure 39: Number of Consented Entities

The largest contributors to the trade effluent flow were found to be the water and cement industries. A breakdown of consent holders by industry type is shown in Figure 40 below.

Consent Holders by Industry Type

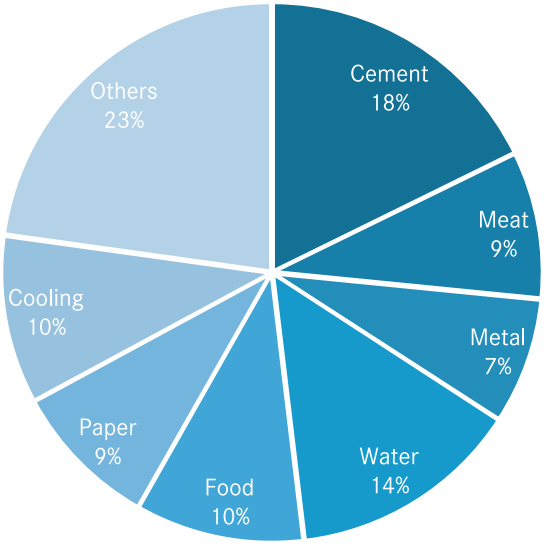


Figure 40: Consent Holders by Industry Type

ADSWS categorises its consent holders as high, medium, or low risk according to the size, nature of discharge, and consent holder performance history. This categorisation is used to define the sampling and inspection frequencies for each consent holder. Based on this ADSWS conducted 323 sampling and inspection assessments of consent holders in 2023. Figure 41 illustrates the number of sampling events since 2015.

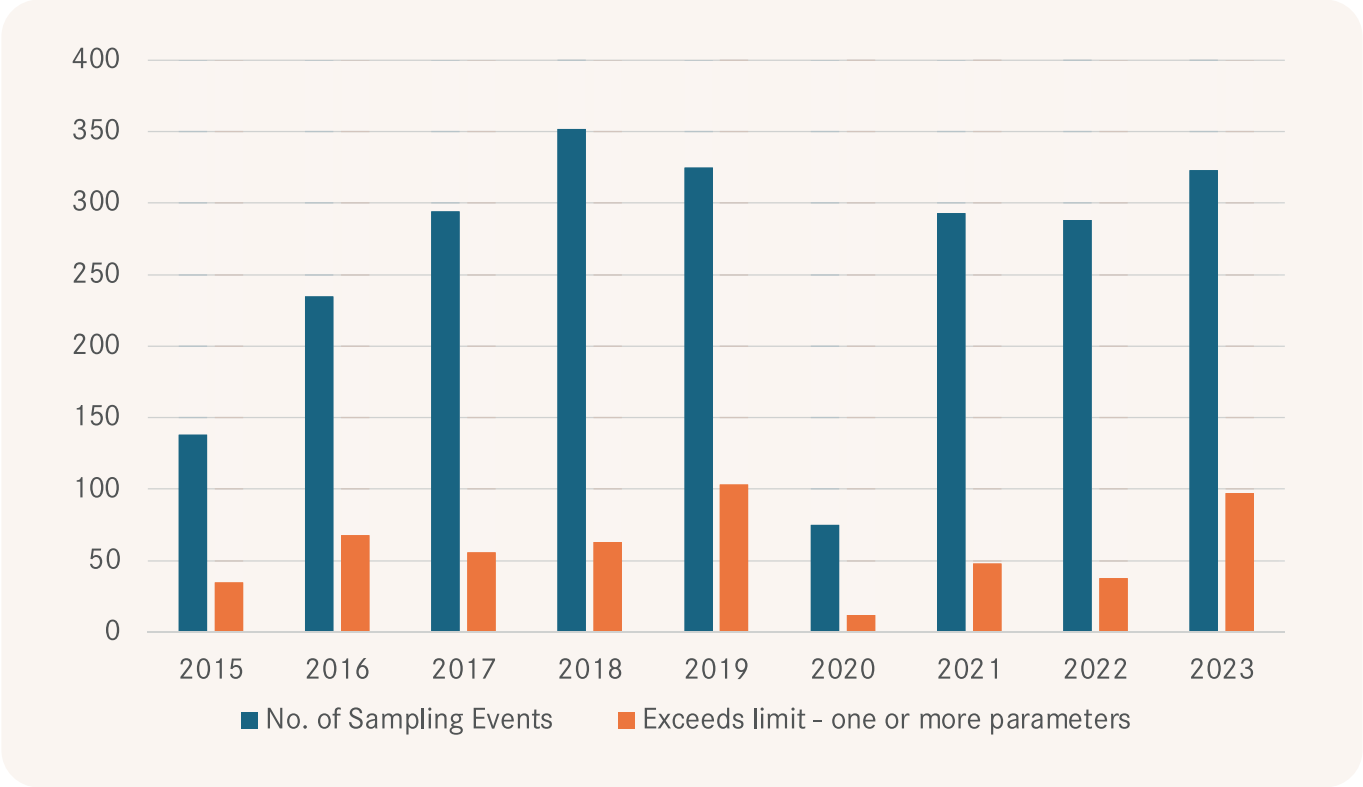


Figure 41: Number of Sampling Events

The most commonly exceeded parameters were pH, TSS and COD. These exceedances were related primarily to the slaughterhouses, cement and cooling factories.

ADSWS issued 36 improvement notices and 17 observation notices which required consent holders to address issues associated with sample failures or issues identified during inspections.
The DoE recognises that the technical and financial effort involved with issuing and monitoring Trade Effluent consents for certain types of Trade Effluent is disproportionate to the risks posed to the receiving sewerage systems. Accordingly, these discharge types are designated as Low Risk Trade Effluent (LRTE) and are managed by ADSWS through Codes of Practice.

There are currently three Codes of Practice in place covering restaurants and cafes, small-scale laundries, and vehicle washes. Figure 42 below shows the number LRTE entities inspected from 2015 through 2023 and the corresponding number of issues encountered during the inspections.
Restaurants and cafes continue to constitute the bulk of ADSWS's inspection workload and an increase in the number of the total LRTE registered was noted in 2023. The main issues encountered by ADSWS inspectors were related to grease trap maintenance.

LRTE

Figure 42: Breakdown of low-risk Entities by Type of Business

Treatment

Wastewater treatment is defined as the reception of wastewater from the collection system, the treatment of the wastewater and delivery of the resulting products to the disposal system. In 2023, Saadiyat 2 treatment plant was handed over for operation to ADSWS bringing the total number of treatment plants operated by ADSWS to 41 with a corresponding overall installed capacity of 1,333 ML/day.

Over 90% of the total flow in the Emirate of Abu Dhabi continues to be handled by 5 treatment plants: Mafraq, Al Wathba 1 and Al Wathba 2 in Abu Dhabi, and Saih Al Hamah and Al Saad treatment plants in Al Ain.

Figure 43 below depicts the capacities of the 5 largest plants and their average daily flows in 2023. The figure demonstrates that the treatment plants continue to have sufficient capacity to absorb further flows. the average daily flow at Al Saad treatment plant is reaching the to capacity, and expected to increase in coming period, which increase the urgency for a treatment plant upgrade.

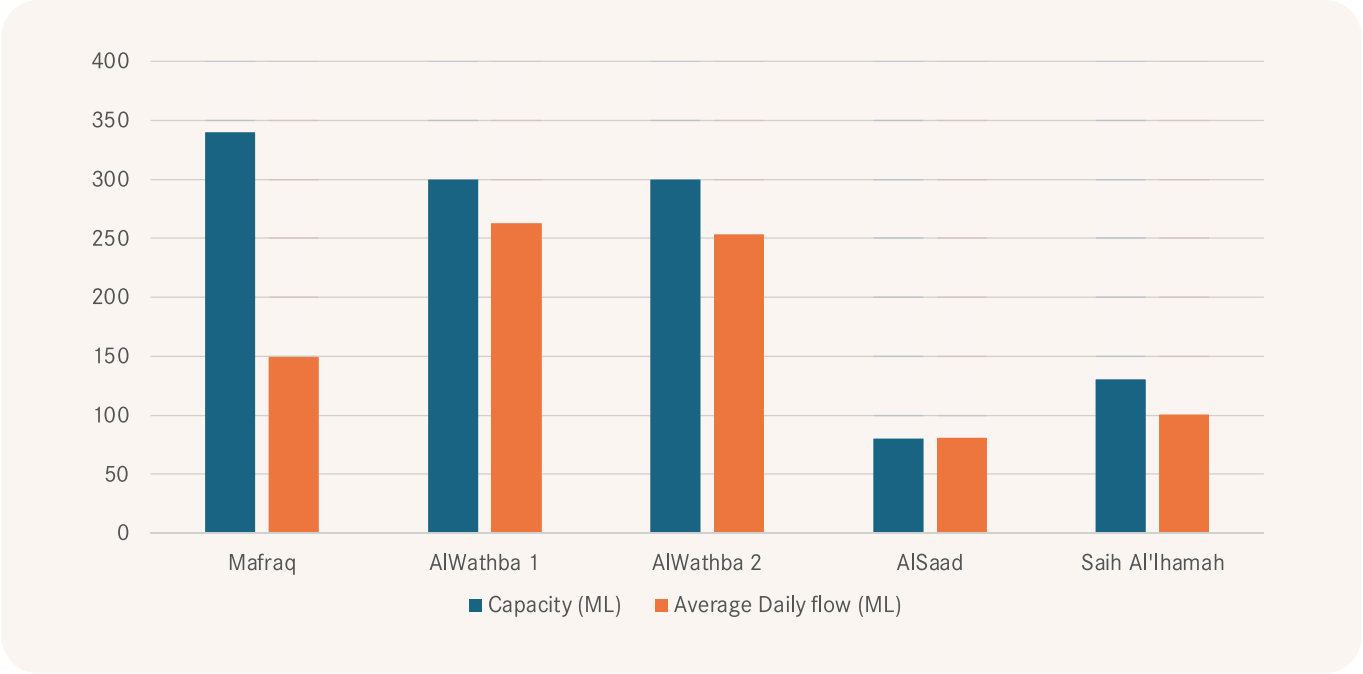


Figure 43: Production and Capacity (ML)

Figure 44 illustrates the total annual flow in the Emirate of Abu Dhabi, and the corresponding flows in each region from 2020 and 2023. A cumulative increase in flow of 8% was recorded between 2020 and 2023.

Annual Flow

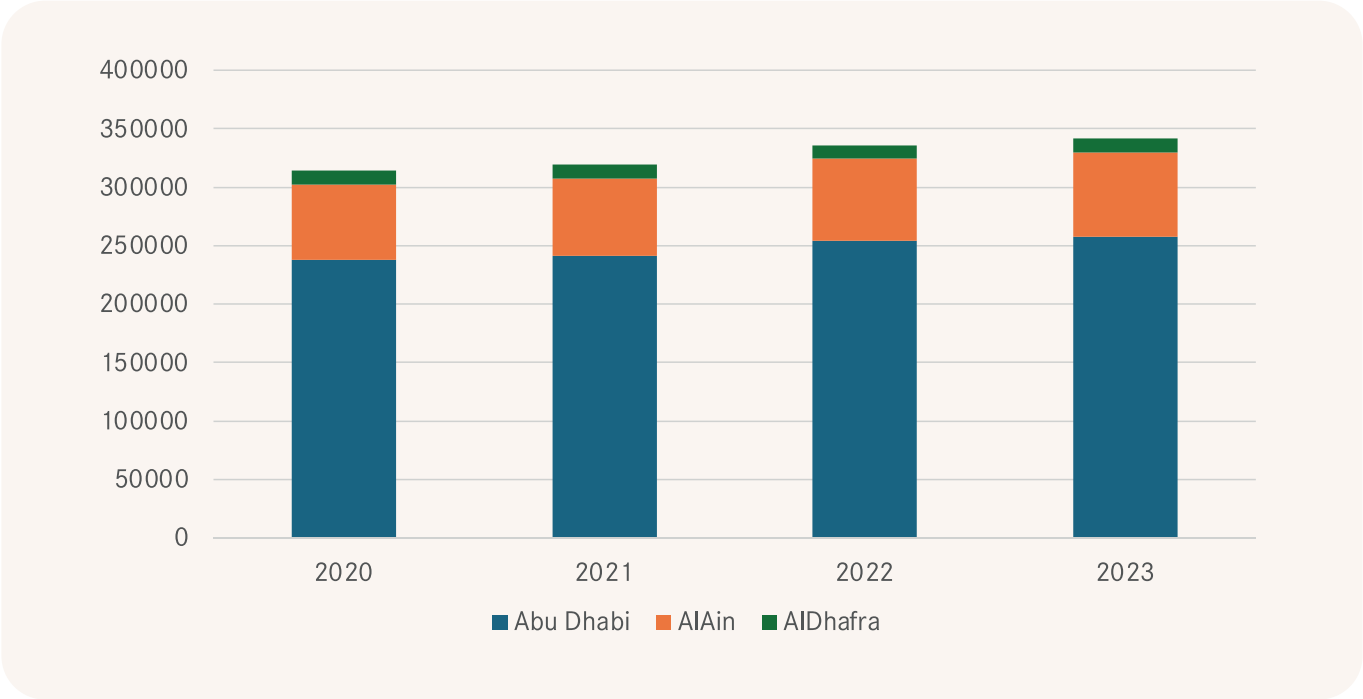


Figure 44: Annual flow data (ML)

Figure 45 Illustrates the proportion of wastewater managed by each of the major licensees in 2023 and highlights the role played by the Independent Sewage Treatment Providers (ISTP) Etihad Biwater and Veolia Besix who manage approximately 75% of the total wastewater treated in the Emirate.

Flow by Licensee

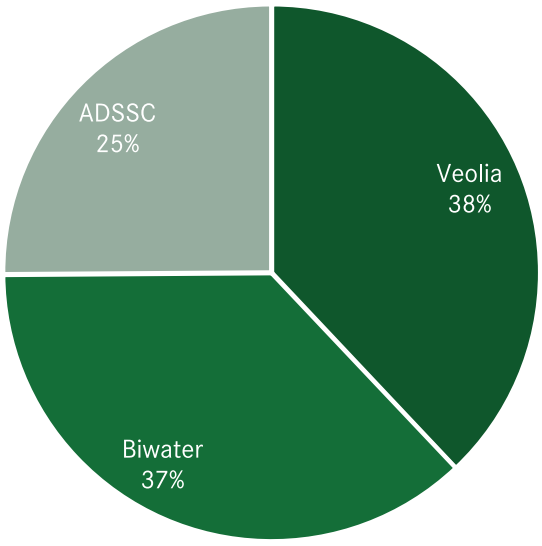


Figure 45: Proportion of Flow Handled by Major Licensees

Quality of Recycled Water at the Disposal Point

The Recycled Water and Biosolids (RW&B) Regulations establish a legal framework for the safe and economic reuse and management of recycled water and biosolids throughout the Emirate. Developing relevant information on the quality of these important products and robust, transparent reporting will highlight compliance difficulties and allow licensees to develop effective operational or project-based solutions to drive year-on-year improvements.

Figure 46 below summarises the recycled water quality compliance for the five major treatment plants operated by large scale licensees from 2015 to 2023 against the sanitary, microbiological and trace elements parameters outlined in the RW&B Regulations. Compliance was assessed by establishing the proportion of samples that passed the relevant standards for the three key parameter groups.

Overall Recycled Water Quality

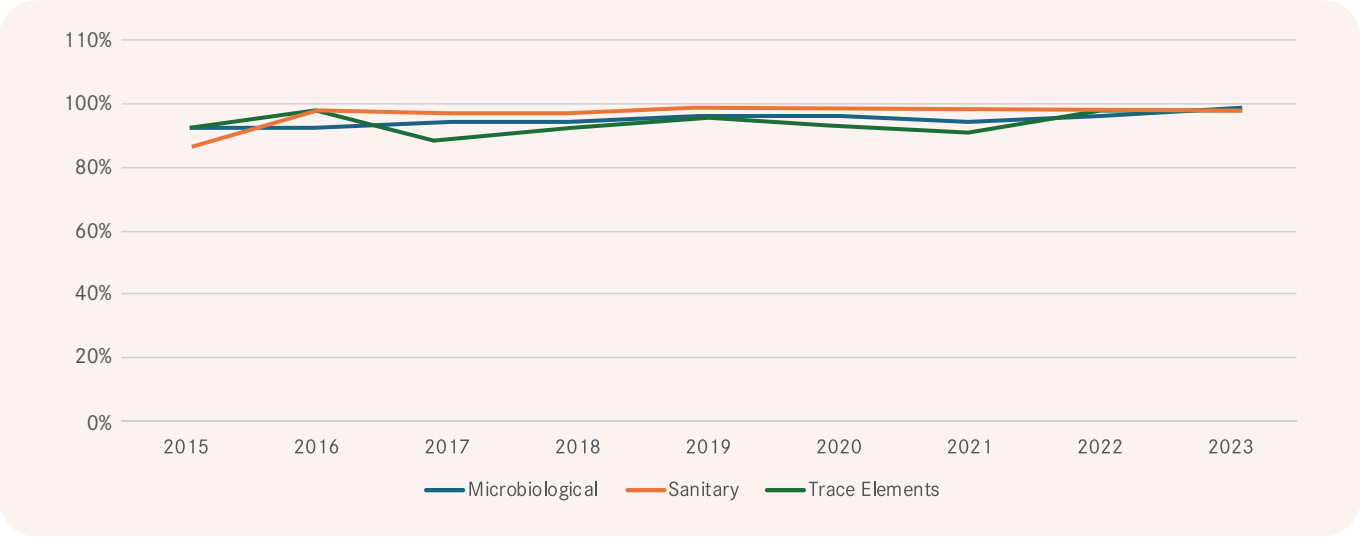


Figure 46: Recycled Water Quality

The data shows significant improvements in compliance against the three key parameter groups over the time period, with excellent compliance reported throughout 2023 for sanitary, microbiological and trace elements parameters.

Additionally, it was noted that salinity continues to be an issue in the raw wastewater entering the Abu Dhabi treatment facilities. This is caused primarily by groundwater infiltration entering the sewerage network through defective pipes, pipe joints, connections, or manholes. Network rehabilitation schemes on Abu Dhabi Island, Mainland and in Musaffah are ongoing to decrease the infiltration affecting the Mafraq, Wathba 1 and Wathba 2 treatment plants.

Quality of Biosolids

Figure 47 below summarises the biosolids quality compliance for the five major treatment plants operated by large scale licensees from 2015 to 2023 against the microbiological and trace elements parameters outlined in the RW&B Regulations.

Trace elements quality was found to be consistent from 2015 to 2023, with any trace elements related issues being followed up by ADSWS as part of their trade effluent control programme. Additionally, an increase in microbiological quality was noted in 2023. The DoE granted a temporary relaxation of the regulatory limits whilst ADSWS investigates treatment processes and process efficiencies in removing microbiological contaminants.

Overall Biosolids Quality

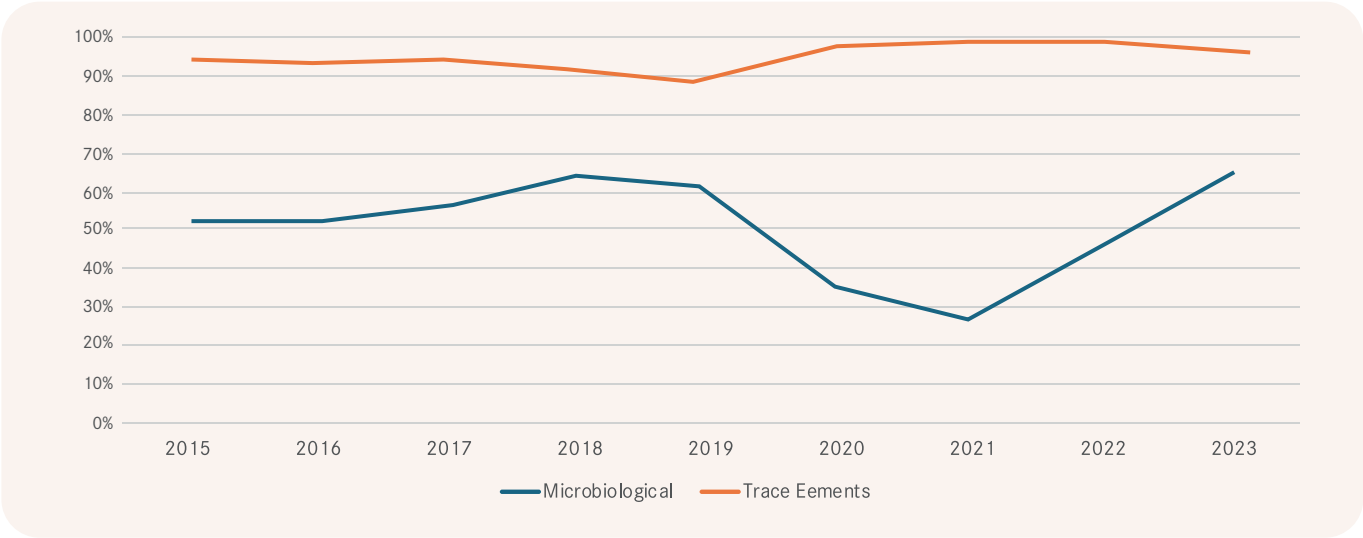


Figure 47: Biosolids Quality

Distribution & Supply

Recycled Water Distribution and Supply Assets

The DoE issued Licenses to both ADDC and ADDC for the distribution and supply of recycled water effective 1 January 2018. Accordingly, the entire recycled water distribution and supply network has been transferred to the distribution companies from ADSWS and from the municipalities. Distribution companies operate the recycled water network to transport recycled water from ADSWS to customers such as municipalities and several commercial entities. Currently Recycled water is being used as a valuable source of water for landscape irrigation and beautification of the city.

Table 4 below provides an overview of the existing recycled water asset base. ADDC and AADC are continuing with projects to enumerate the quantity of assets that were handed over, assess the asset condition of the transferred network, expand their networks, and enhance metering at the connection points with their customers.

Table 5 Recycled water assets

	AADC	ADDC	Total
Total Pipeline Length (Km)	560	1242	**1,802**
Number of Existing Interface Points with ADSWS	14	24	**38**
Number of Connections with Customer	150	442	**592**

Recycled Water Reuse

The products of wastewater treatment are a valuable source of water, nutrients and energy. The DoE believes that the wastewater sector must promote the reuse of recycled water and biosolids to support the Emirate's sustainable development goals.

The Recycled Water & Biosolids Regulations have been developed to maximise the social and economic benefits associated with recycled water and biosolids reuse and to minimise the risk to public health and the environment.

The Regulations outline the prohibitions for recycled water use, and the standards to be followed depending on the level of exposure to the general public. The predominant use for recycled water currently in the Emirate of Abu Dhabi is landscape irrigation. The DoE supports further end-use activities (e.g. industry, agriculture) whilst noting that further polishing or processing of the recycled water may be necessary and is the commercial choice and responsibility of the End-user.

A total of approximately 72% of the recycled water is currently used in the Emirate of Abu Dhabi. Figure 48 below shows the change in recycled water usage in each of the 3 regions. Whilst almost all of the recycled water produced in Al Ain is used every year, ADDC is working on projects to increase the reuse percentage in Abu Dhabi.

Recycled Water Reuse % by Region

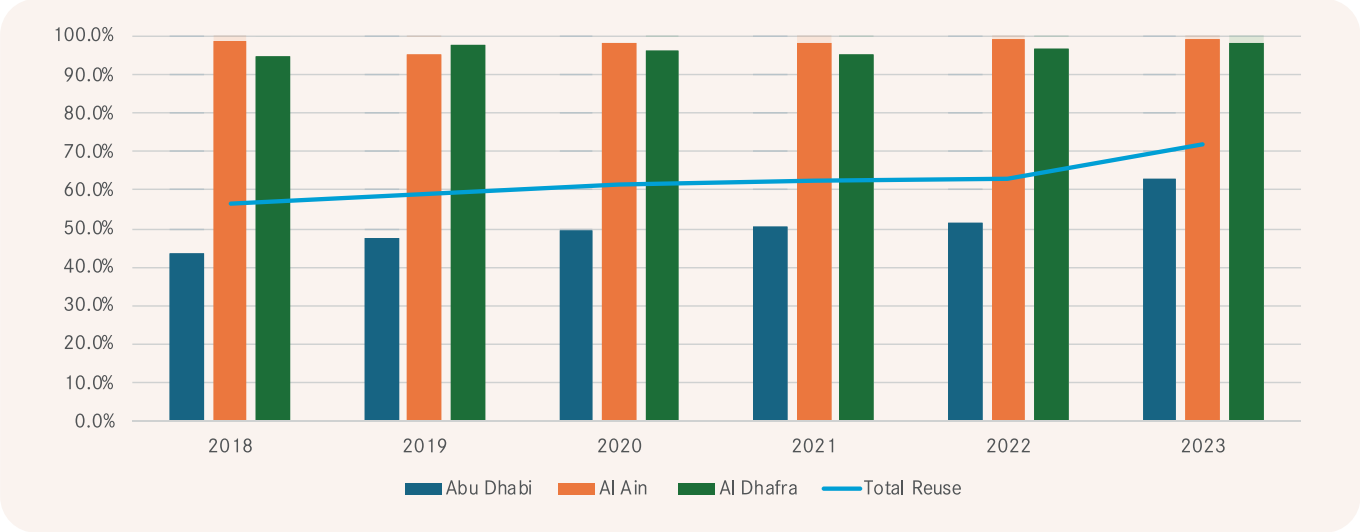


Figure 48: Recycled water Reuse

Biosolids

Only the five large treatment plants have treatment systems that can stabilise sewage sludge sufficiently for reuse as biosolids. All of the biosolids are currently being disposed to landfill subject to the regulation of the Environment Agency Abu Dhabi and the operation of The Centre of Waste Management. To divert the disposal away from landfill, ADSWS is actively seeking reuse outlets such as land application in forest preserves and potential industrial applications.

Figure 49 shows the amount of biosolids produced from 2015 to 2023. The production has remained relatively stable during the time period with annual fluctuations noted due to biosolids storage at the treatment plants. The total dry mass of biosolids produced in the Emirate in 2023 was 56139 tons.

Total biosolids produced

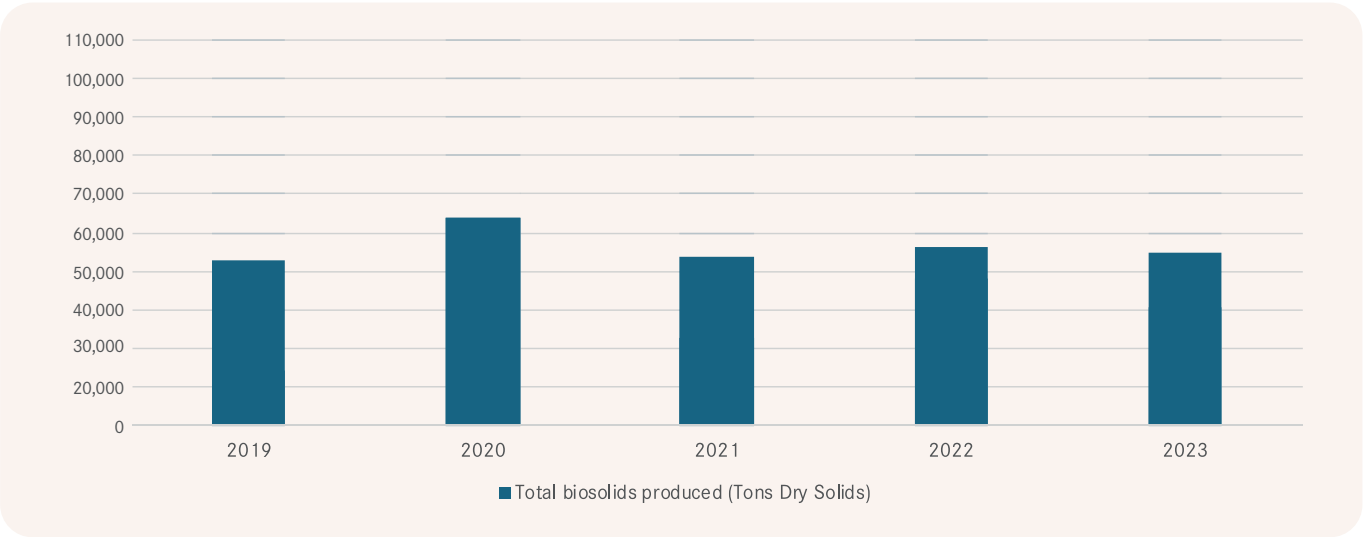


Figure 49: Biosolids Production

Self-Supply Licensees

In recent years, the DoE has observed several companies operating small scale sewerage systems throughout Abu Dhabi Emirate and has managed to bring many of these companies into compliance with the DoE's regulations by issuing licences to unlicensed facilities. Treatment capacities of these small-scale sewerage systems are 10,000 m3/day and below.

There was a total of 38 small scale wastewater, treatment and disposal entities with licenses in 2023. Although none of the licensees provide recycled water quality to customers outside of their boundaries, the DoE has worked to improve compliance through organising education and awareness workshops with the licensees. Additionally, those licensees that do not provide demonstrable improvement in performance are referred to the DoE's licensing and compliance department for further actions.

7. Health and Safety

Introduction

The DoE is the Sector Regulatory Authority (SRA) for the energy sector in the Emirate of Abu Dhabi. The DoE has been entrusted as the point of contact with the government to update them with any matters related to the sector, including the management of operational and HSE incidents.

To fulfil this mandate, the DoE is managing HSE through two workstreams:

1. License requirements: DoE is responsible for licensing the activities of power generation, water desalination, wastewater collection, treatment and disposal, and district cooling, and HSE requirements are part of the license conditions.

2. SRA requirements: DoE is the Sector Regulatory Authority for the Energy sector and is responsible for supervising the Abu Dhabi Occupational Safety and Health System Framework implementation.

HSE Performance

The DoE monitors the licensee's HSE performance through multiple tools including:

1. Incident Reporting System (IRS), which enables DoE to monitor the operational incidents and the corrective actions taken by the Licensees to ensure that all CA are implemented, and the best practices are used to prevent the re-occurrences.

2. HSE Monthly performance reports, which designed by DoE experts to monitor 23 KPIs that related to different HSE matters related directly to the health being of the working power in the energy sector as well as those related to asset safety and environment issues. this report submitted periodically by the Licensees to the DoE.

3. AL ADAA Soft link, which represents the reporting tool to ensure the implementation of ADOSH-SF that enables DoE to monitor the OSH Incidents and the quarterly performance of all registered Licensees in AL ADAA.

4. HSE Audit and Inspection process through site visits to test system implementation and identify improvement opportunities for the audited entities.

Incident Reporting

Incident reports are classified into three broad categories.

- Occupational Health & Safety (OSH).
- Operational; and
- Environmental.

OSH Incidents

OSH incidents are defined as a single event or chain of events which has caused or has the potential to cause a fatality, injury or illness to a person, or damage to assets, or the reputation of any Entity.

The categories of these incidents include:

- Work-Related Fatality which is a death resulting from a work-related injury or illness, regardless of the time intervening between injury and death.
- Serious Injury An incident causes an injured person temporarily/permanently unable to perform any regular job or restricted work activity on a subsequent scheduled workday or shift, supported by a medical report from an approved medical practitioner. Some serious injuries could lead to fatality.
- Serious Dangerous Occurrence a significant incident arising out of or in the course of work that did not result in injuries and/or fatalities but had the potential to have done so.
- Serious Occupational illness/Disease Any work-related abnormal condition or disorder, other than an injury, which is mainly caused by exposure to environmental factors associated with the employment.

There were 27 total OSH incidents reported in 2023.The breakdown of these incidents by sector is shown in Figure 50 below.

2023 Total OSH Incidents - by Sector

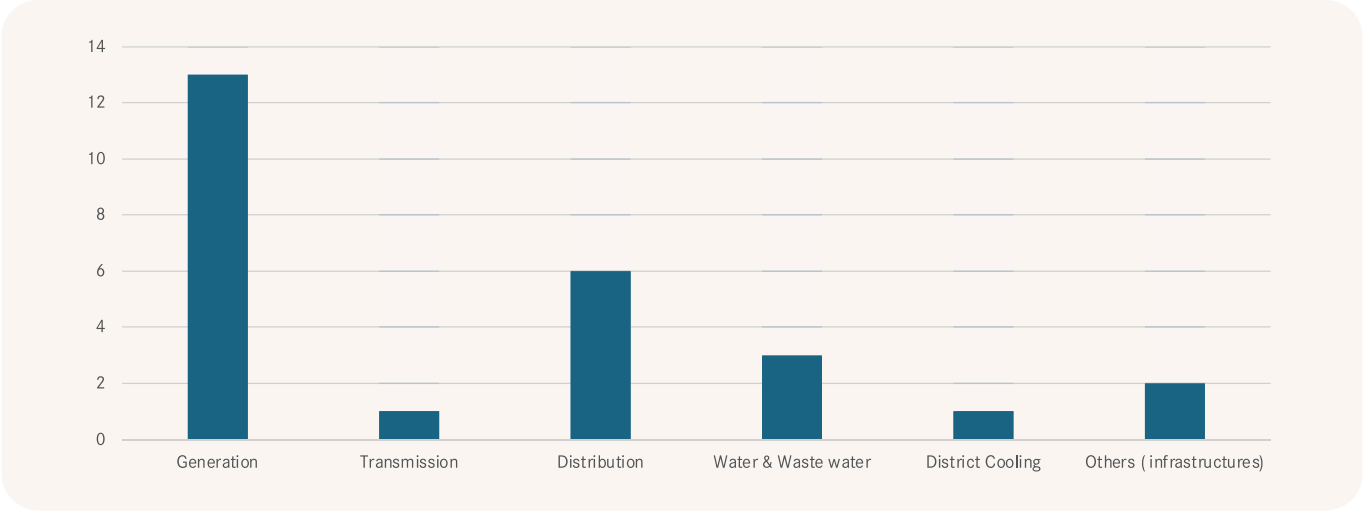


Figure 50: OSH Incidents by sector

he OSH incidents that occurred during 2023 were classified into 4 categories: serious injury, serious dangerous occurrence, serious occupational illness/disease and fatality. These are shown on Figure 51 below.

2023 OSH Incidents by category

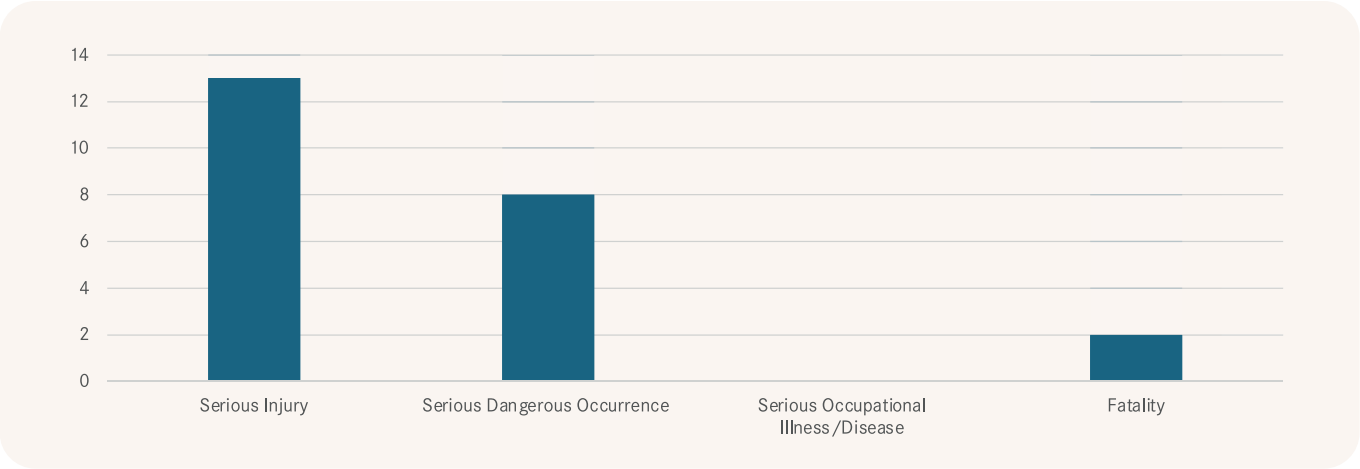


Fig. 51 – OSH incidents by category

Operational Incidents:

Operational incidents are defined as events that result in an interruption of service provided by the Licensee.

Operational incidents are classified based on the activities to:

- Power operational incidents (including power generation, transmission, and distribution)
- Water operational incidents (including water desalination, transmission, and distribution)
- Power, water operational incidents (including water desalination, transmission, and distribution)
- Wastewater operational incidents (including the wastewater collection, treatment, and recycled water distribution and supply)
- District cooling (including all OSH incidents reported by district cooling sector)
- Others (infrastructure) {include all OSH incidents reported by other licensees category such as EWEC head office or EWEC – LDC, ...etc)

In 2023 the DoE received and processed 555 operational incident reports; 28 of which were considered critical and required reporting within 5 hours. The remaining incidents are reported under the 12 hours or 24 hours reporting category. The breakdown of the incidents by sector is shown in Figure 52 below.

Operational Incidents in 2023

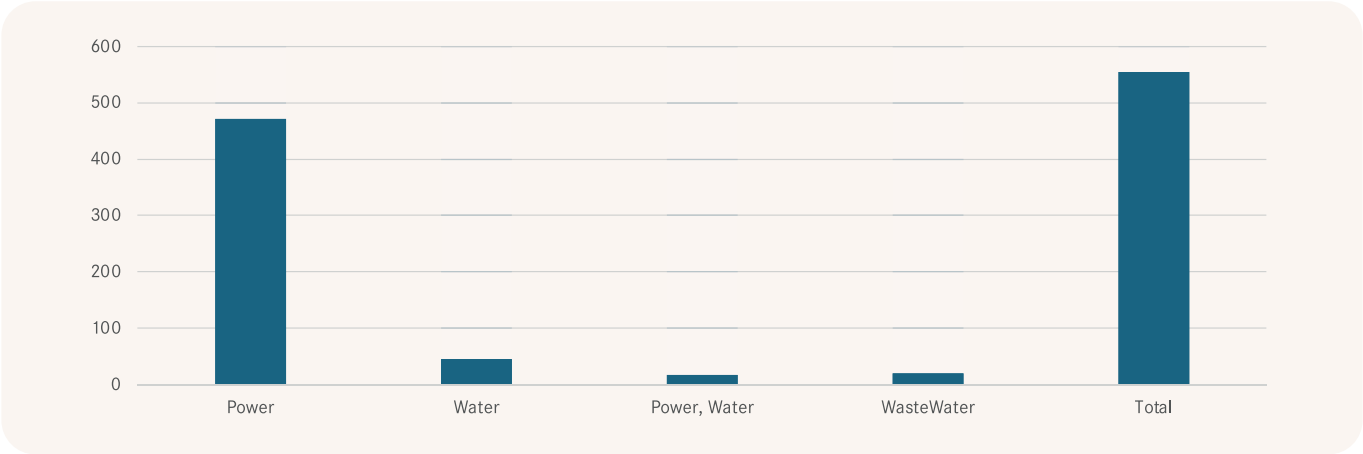


Figure 52: Operational Incidents in 2023

Operational Power Incidents:

A total of 473 operational power incidents were reported in 2023. The most critical operational power related incidents fell into three specific categories:

- Total Plant trips (Electricity)
- An interruption on any 33kV, 22kV and 11kV bus bar section at any grid station (220/33, 132/33, 132/22, 132/11kV)
- Any interruption of demand above 15MW for a period in excess of 3 minutes

The DoE reviewed all the incidents, the reported root causes and ensured that the proposed action plans were fit for purpose. Furthermore, the DoE conducted an annual meeting with all the Licensees to discuss the most serious operational incidents and the necessary actions to prevent recurrence.

Operational Water Incidents

There were 60 operational incidents reported in the production network in 2023. There were 2 operational incidents reported in the transmission network in 2023. There were no incidents reported in the distribution network in 2023. Most of the incidents have not affected the security of supply. The DoE reviewed all the incidents, the reported root causes and ensured that the proposed action plans were fit for purpose. Furthermore, the DoE conducted regulatory meetings (quarterly and as and when required) with all the Licensees to discuss the operational incidents and the necessary actions to prevent recurrence.

Operational Wastewater Incidents

There were 19 operational incidents reported in the wastewater sector and in all cases no disruption was caused to the public. The incidents were mainly related to sewer collapses. The DoE reviewed all the incidents, the reported root causes and ensured that the proposed action plans were fit for purpose.

Environmental Incidents

Environmental Incidents are defined as events resulting in an unplanned or uncontrolled release of a product or chemical with negative impact to the environment – water, air, soil, animals, plants, ecology and social life. There were no significant environmental incidents reported by the sector in 2023.

8. Environment

The DoE ensures that environmental protection is a priority in all operations within the energy sector. A dedicated team is assigned to oversee the environmental performance in the sector as well as to ensure all operations are aligned with the Emirate's legal requirements.

The DoE works closely with the Environment Agency- Abu Dhabi to ensure compliance with all regulations and agreed protocols for the energy sector. Also, the DoE is a part of the consultation process for all environmental matters related to the energy sector through participating in working committees and groups and reviewing environmental regulations and guidelines.

Each quarter, 19 sector companies submit their environment reports including Marine Water Quality, Air Quality and Waste management to DoE for monitoring and review. The DoE HSE team have reviewed around 102 environmental reports in 2023.

The DoE monitors the environmental performance of all licensees on a quarterly basis. The licensees submit an environmental report summarizing the data collected regarding air quality emissions, sea water inlet and outfall discharge, and the waste register throughout the reporting period.

Additionally, the CO2 emissions in the energy sector are monitored on a regular basis. The total CO2 emissions in 2023 were 34 Million Tons.

Total CO2 Emissions in Tons (2019 - 2023)

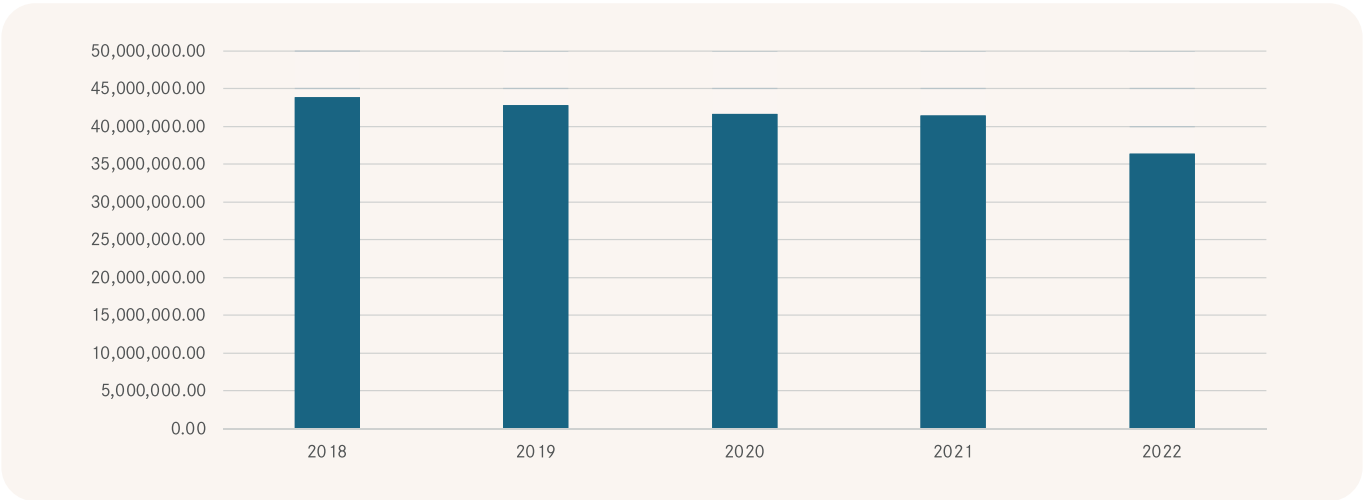


Figure 54: CO2 emissions MetricTons (2019 - 2023)

9. District Cooling

The Abu Dhabi Department of Energy issued the District Cooling Regulation and the District Cooling Applicability Regulation which have been in effect since September 2019.

The Abu Dhabi Government thus becomes the first administration in the Middle East and North Africa region to set up a complete integrated system for district cooling. This, reflects the DoE's commitment to taking the lead in the regional and global energy sector, highlighting its focus on developing infrastructure, ensuring energy efficiency, and promoting sustainable solutions.

The new regulations aim to unify standards, integrate efforts to regulate the sector, ensure the highest quality and competitiveness for energy services, and protect consumer rights. The regulations also include clauses to enhance energy efficiency, protect the environment, and encourage investments in the sector.

The District Cooling Regulation, and the DC Applicability Regulation, provide a regulatory framework for these activities in the Emirate of Abu Dhabi, offering investors, consumers, and the public, safe, efficient, and economical cooling services.
The District Cooling Regulation covers technical performance standards and minimum guidelines, market competition and price regulation, minimum contractual requirements, and requirements for licensing.

The District Cooling Applicability Regulation aims to ensure developers study the feasibility of district cooling at the master planning stage to ensure the optimal use of energy infrastructure, and to promote more efficient cooling systems for areas where it can be applied efficiently. In addition, it supports expanding the scope of the district cooling system in the emirate by managing demand for it and encouraging the use of this technology.

District Cooling Regulations Implementation

Licenses Issued as of 2023

As of 2023, DoE reviewed, engaged, and discussed with the sector companies the submitted license applications and subsequently issued (15) licenses in Abu Dhabi as shown in table 6.

Figure 55 shows the licensed DC schemes total ultimate capacity of 390,000TR out of Abu Dhabi's total existing District Cooling capacity undergoing grandfathering review.

Licensed Capacity Up to 2023

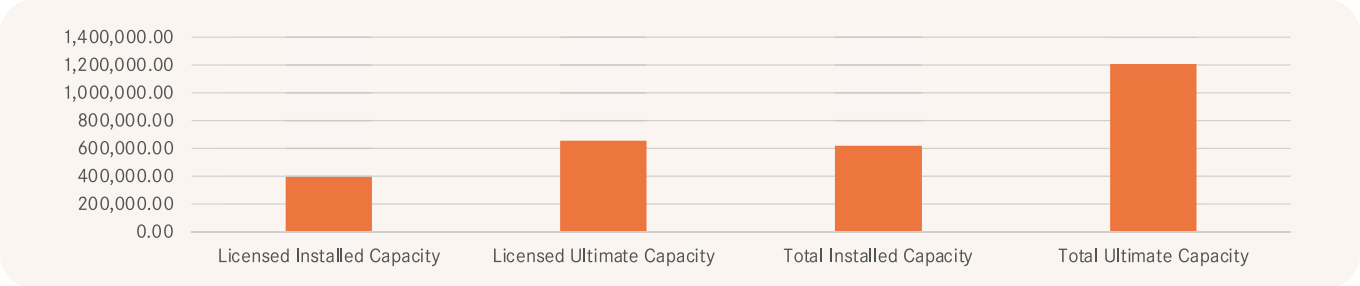


Figure 55 Licensed Capacity as of 2023

Table 6 DC Licenses Issued up to 2023

#	Licensee	DC Scheme/Serving	License Type	Installed Capacity (TR)	Ultimate Capacity (TR)*
1	Al Wajeez Development CO. PJSC (AWDC)	Al Maryah Island	DC Provider Standalone	40,000 + 10,000 (TES)	40,000 + 10,000 (TES)
2	Saadiyat Cooling L.L.C (SCL)	Saadiyat Beach and Saadiyat Cultural District	DC Provider Integrated	21,250	70,000
3	Saadiyat District Cooling L.L.C (SDCL)	NYU Abu Dhabi	DC Provider Standalone	9,000 + 2500 (TES)	9,000 + 2500 (TES)
4	National Central Cooling Company PJSC (Tabreed)	S&T, Shams 5&6 area (Al Reem Island)	DC Provider Integrated	20,000	25,000
5	PAL Danat Cooling LLC	Danat Development	DC Provider Standalone	10,000	30,000+7,500 (TES)
6	PAL Saraya Cooling LLC	Saraya Development	DC Provider Standalone	10,000	20,000
7	PAL Shams Cooling LLC	Saraya De Shams Development	DC Provider Standalone	10,000	107,000
8	PAL Cooling LLC	ADNEC area	DC Provider Standalone	20,000	25,000
9	PAL First Cooling	Tamouh Development	DC Provider Integrated	65,000	90,000
10	PAL Najmat Cooling	Najmat Development	DC Provider Standalone	-	103,000
11	National Central Cooling Co. (Tabreed)	Raha Beach	DC Provider Integrated	45,000	45,000
12	National Central Cooling Co. (Tabreed)	Raha Gardens	DC Provider Integrated	37,500	50,000
13	National Central Cooling Co. (Tabreed)	Central Market	DC Provider Integrated	15,000	30,000
14	National Central Cooling Co. (Tabreed)	Yas Island	DC Provider Integrated	45,000	88,000
15	Al Reef Cooling LLC	Al Reef Development	DC Provider Integrated	8,000	8,000

*At full built out

System Performance Overview

As part of the ongoing monitoring of the DC licensees and in accordance with the DC Regulations, each licensee is required to submit their Annual Information Submission by the end of first quarter of each year, reporting their financial performance and their technical operational performance by providing compliance against the following KPI's as defined in the DC Technical Code.

Table 7 DC Licensees Compliance

	Unit	Limit
KPI 1: System Reliability	% of hours	99.5%
KPI 2-5: Electricity Efficiency	kWh/kWhc	0.25-0.26
KPI 6: Water Consumption for Condenser Cooling	liters/kWhc	2.33
KPI 7: Water Consumption for Chilled water make up	Max annual %	2%
KPI 8: Cooling Water Circulating Quality	Legionella Colony Forming Units per ml of circulating water	100
KPI 9: Metering equipment Maximum Service Intervals	Years	5/10
KPI 10: Maximum Number of Meter Components failing achieve required accuracy level	Max % of Components Failing to Meet Accuracy Level During Periodic Testing	10%
KPI 11: Customer Complaint and Dispute Resolution		100%

The licensees demonstrated compliance with all KPIs and requirements of the DC codes for 2023 by achieving satisfactory limits.

KPI 1: System Reliability

System Reliability is an indicator for the availability of the DC systems and the ability of the DC providers to satisfy the cooling load requirements for the reporting period taking into consideration any unplanned interruption of the service.

As shown in Figure 56 below, all DC providers were able to achieve 100% for the reliability KPI for the years 2019-2023, proving the robustness of the district cooling infrastructure in Abu Dhabi.

System Reliability

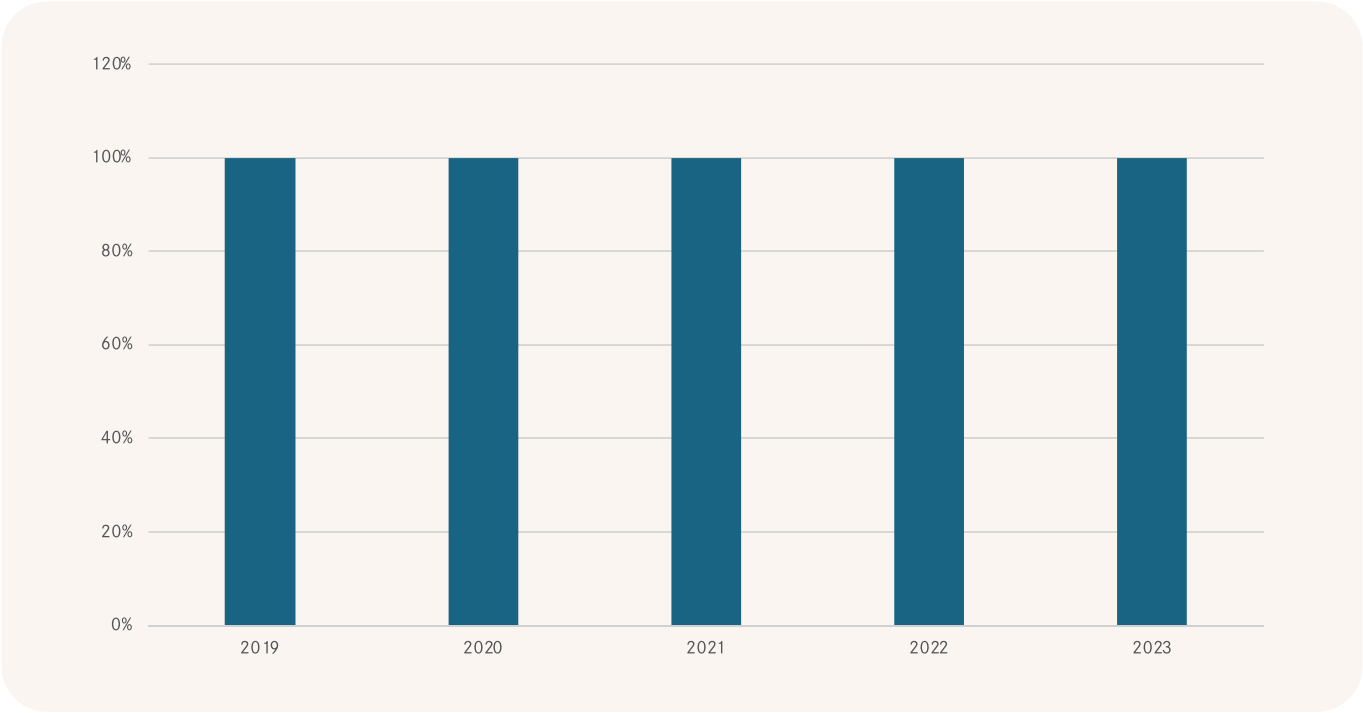


Figure 56 System Reliability

KPI 2-5: Electricity Efficiency
This KPI addresses the energy efficiency of the DC systems which is the ratio between the plant annual electricity consumption and the annual cooling energy produced measured in kWh/kWhc.

Figure 57 below shows the average energy consumption for the licensed DC schemes where it illustrates an improvement over the years from 2019 – 2023.

Average Electricity Consumption

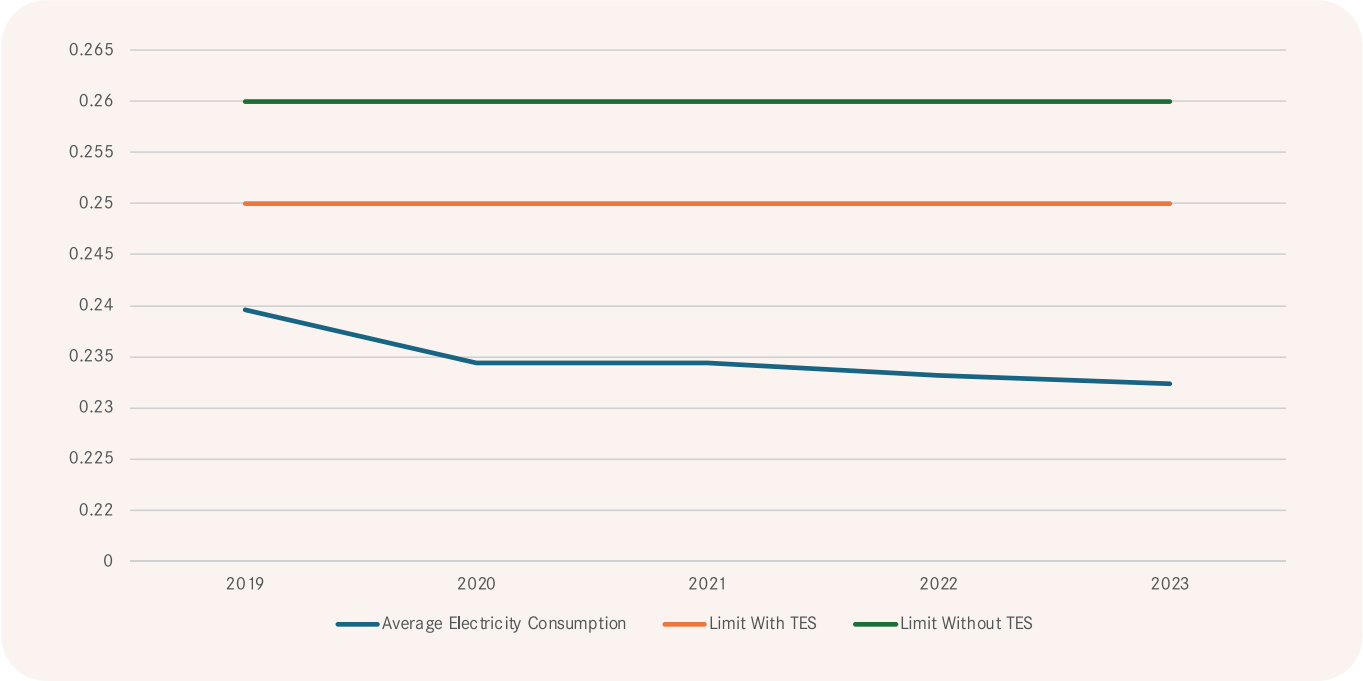


Figure 57 Average Electricity Consumption

KPI 6: Water Consumption for Condenser Cooling
This KPI determines the efficiency in water management in the DC plants represented as the ratio between the total annual water consumption (cooling tower make up and auxiliary water uses) to the total annual cooling energy production measured in liters/kWhc.

Figure 58 below shows the average water consumption for the licensed DC schemes demonstrating the continues efforts of the DC sector companies achieving lower consumption values year over year.

Average Water Consumption

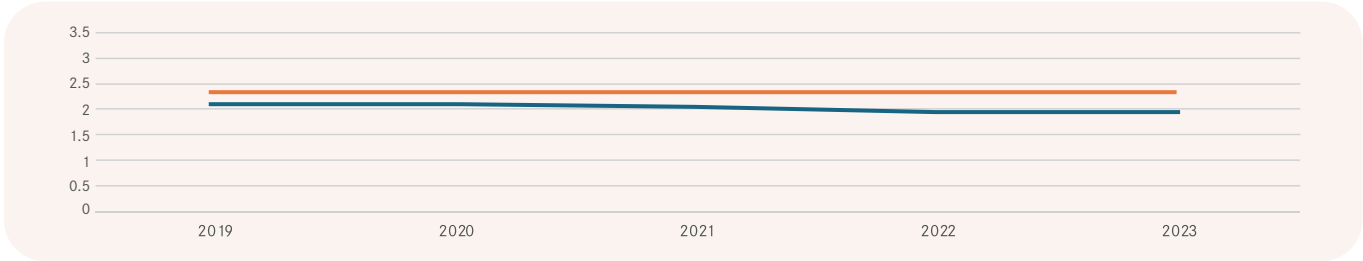


Figure 58 Average Water Consumption

9. Acknowledgment

Abu Dhabi Department of Energy (DoE) has prepared this 2023 Technical Report in collaboration with Abu Dhabi energy sector's stakeholders. DoE extends its gratitude and appreciation to all participating entities for their cooperation, transparency, and integrity in submitting the required reports and data as per the applicable regulations.

Participating Entities:

EWEC
ADDC
AADC
TRANSCO
ADSSC
AMPC
APC
ECPC
FAPCO
GTTPC
MIPCO
RPC
SAPCO
SCIPCO
SEMBCORP
SHAMS
TAPCO
Al Etihad Biwater Wastewater Company (EB)
Al Wathba Veolia Besix Wastewater Company (VeBes)
National Central Cooling Company (Tabreed)
PAL Cooling Holding