هـيـئـة الـبـيـئـة - أبـوظـبـي
Environment Agency - ABU DHABI

AIR QUALITY
ANNUAL SUMMARY REPORT
ABU DHABI
2020

01

INTRODUCTION

The objective of EAD's air quality priority is to ensure that ambient air quality in Abu Dhabi protects human health and the environment. EAD will focus on improving the comprehensiveness of ambient air quality monitoring across the emirate, advancing capabilities for analysing, modelling and reporting air quality information, and ensuring that emission standards, regulations and enforcement regimes are in place for the key sectors and pollutants that pose the greatest threats to public health, wildlife, and quality of life in Abu Dhabi.

The Environment Agency – Abu Dhabi (EAD) started monitoring air quality in 2007. Quality Assurance/Quality Control (QA/QC) methods and procedures are implemented with full documentation and are validated through an international certified calibration reference laboratory. Forms and log sheets document every activity in the air monitoring stations and document all maintenance, calibration, operation and other activities such as all visits to the stations.

This annual report provides an overview and analysis of air quality monitoring data in Abu Dhabi for the year 2020, and a short comparison of monitoring results with earlier years. The analysis covers the three regions in Abu Dhabi Al Ain Region (Eastern Region), Al Dhafra Region (Western Region) and Central Region (Greater Abu Dhabi and its surrounding).

The report summarizes the data available at the twenty fixed stations in Abu Dhabi Emirate, in addition two mobile stations. The network monitors up to 17 parameters.

AIR POLLUTION SOURCES AND HEALTH EFFECTS

POLLUTANT

SULFUR DIOXIDE SO_2

- Traffic pollution
- Fuel Combustion
- Electric Utilities
- Industrial Processes
- Oil and gas activities

CARBON MONOXIDE CO

- Traffic Pollution
- Fuel Combustion

NITROGEN DIOXIDE NO_2

- Traffic Pollution
- Fuel Combustion
- Electric Utilities
- Industrial Boilers

PARTICULATE MATTER PM

- Arid climate
- Regional dust clouds
- Fuel Combustion
- Industrial processes
- Traffic Pollution
- Construction Activities

OZONE O_3

- Secondary pollutant typically formed by photochemical reaction of volatile organic compounds (VOCs) and NOx in the presence of sunlight.

HYDROGEN SULFIDE H_2S

- Sewage Network
- Oil and Gas industrial activities
- Waste-water treatment plants

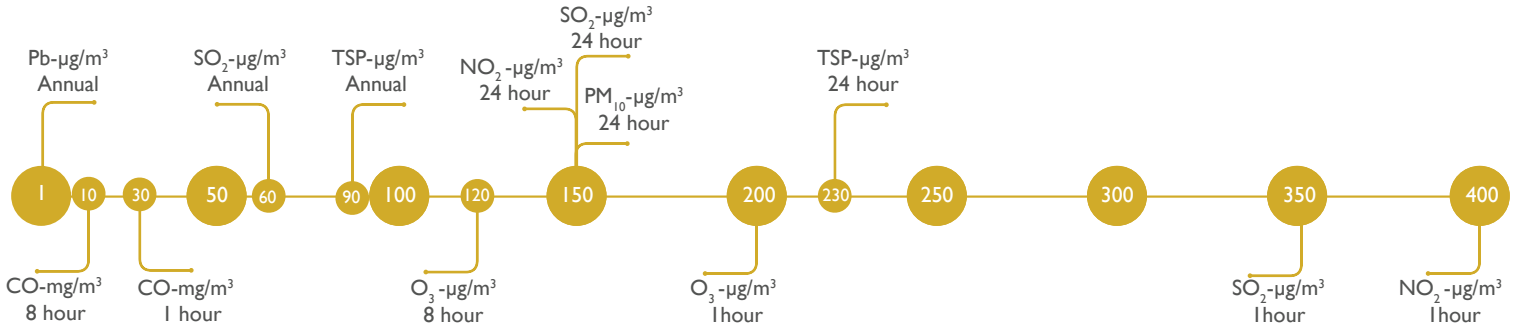
Respiratory diseases Cardiovascular diseases Odor nuisance

02

03

AMBIENT AIR QUALITY LIMITS (AQL)

The air pollution levels have been compared to the UAE Air Quality Limits defined in the Cabinet of Ministers Decree No. 12 for 2006 concerning Protection of Air from Pollution. A summary of these Ambient Air Quality Limit (AQL) concentration levels is presented bellow.



*TSP = Total Suspended Particles

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AIR QUALITY INDEX

This report establishes the Air Quality Index (AQI) to evaluate air pollution. EAD simplifies the Ambient Air Quality State by calculating the AQI Range based on Air Quality National Standards for the major five parameters; Particulate matter, Ground level ozone, Sulfur dioxide, Nitrogen dioxide and Carbon monoxide.

AQI values that are below 100 are compliant with the air quality limits and are therefore considered to be acceptable.

US EPA AQI Classifications

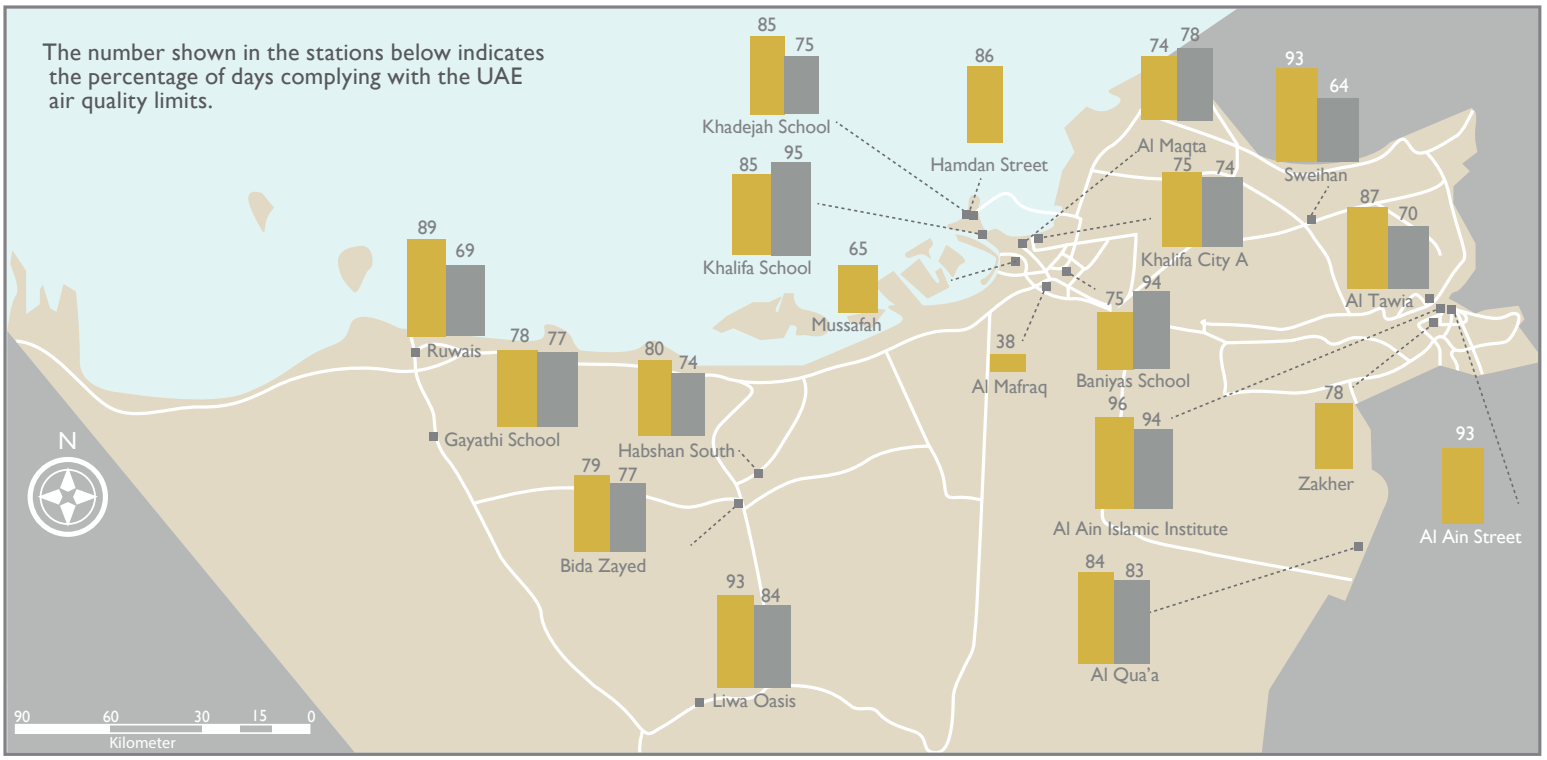
AQI RANGE	CLASSIFICATIONS	CONDITIONS
0 to 50	Good	Considered satisfactory
51 to 100	Moderate	Air quality is acceptable
101 to 150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects
151to 200	Unhealthy	Everyone may begin to experience health effects
201to 300	Very Unhealthy	Health alert, meaning everyone may experience more serious health effects.
301 to 500	Hazardous	Health warnings of emergency conditions.

05 AIR QUALITY MONITORING STATIONS

STATION NAME	STATION REPRESENTATIVITY (AREA TYPE)	MAIN PARAMETERS						
		SO_2	NO_2	CO	O_3	PM_{10}	$PM_{2.5}$	H_2S
CENTRAL ABU DHABI AREA								
HAMDAN STREET	URBAN TRAFFIC	●	●	●		●	●	
KHADEJAH SCHOOL	URBAN BACKGROUND	●	●		●	●	●	●
KHALIFA SCHOOL	SUBURBAN BACKGROUND	●	●		●	●	●	●
AL MAQTA	SUBURBAN BACKGROUND	●	●	●	●	●	●	●
KHALIFA CITY A	SUBURBAN BACKGROUND	●	●		●	●	●	●
BANIYAS SCHOOL	SUBURBAN BACKGROUND	●	●		●	●	●	●
MUSSAFAH	SUBURBAN INDUSTRIAL	●	●			●	●	●
AL MAFRAQ	SUBURBAN INDUSTRIAL	●	●			●	●	●
AL AIN REGION								
AL AIN STREET	URBAN TRAFFIC	●	●	●		●	●	
AL AIN ISLAMIC INSTITUTE	URBAN BACKGROUND	●	●		●	●	●	●
AL TAWIA	SUBURBAN BACKGROUND	●	●		●	●	●	●
ZAKHER	URBAN BACKGROUND	●	●			●	●	●
SWEIHAN	SUBURBAN BACKGROUND	●	●	●	●	●	●	
AL QUA'A	REGIONAL RURAL BACKGROUND	●	●	●	●	●	●	
AL DHAFRA REGION								
E11 ROAD	RURAL TRAFFIC	●	●	●		●	●	
BIDA ZAYED	SUBURBAN BACKGROUND	●	●		●	●	●	●
HABSHAN SOUTH	RURAL INDUSTRIAL	●	●		●	●	●	●
RUWAIS	SUBURBAN INDUSTRIAL	●	●	●	●	●	●	●
GAYATHI SCHOOL	SUBURBAN BACKGROUND	●	●		●	●	●	●
LIWA OASIS	REGIONAL RURAL BACKGROUND	●	●		●	●	●	

● Measured Parameters

06 AIR QUALITY STATUS



PM_{10}

O_3

The percentage of compliant days present AQI values below 100, which are normally expected to be satisfactory

THE PERCENTAGE OF COMPLIANT DAYS WITHIN THE YEAR IN ABU DHABI MONITORING STATIONS

SO_2 NO_2 CO

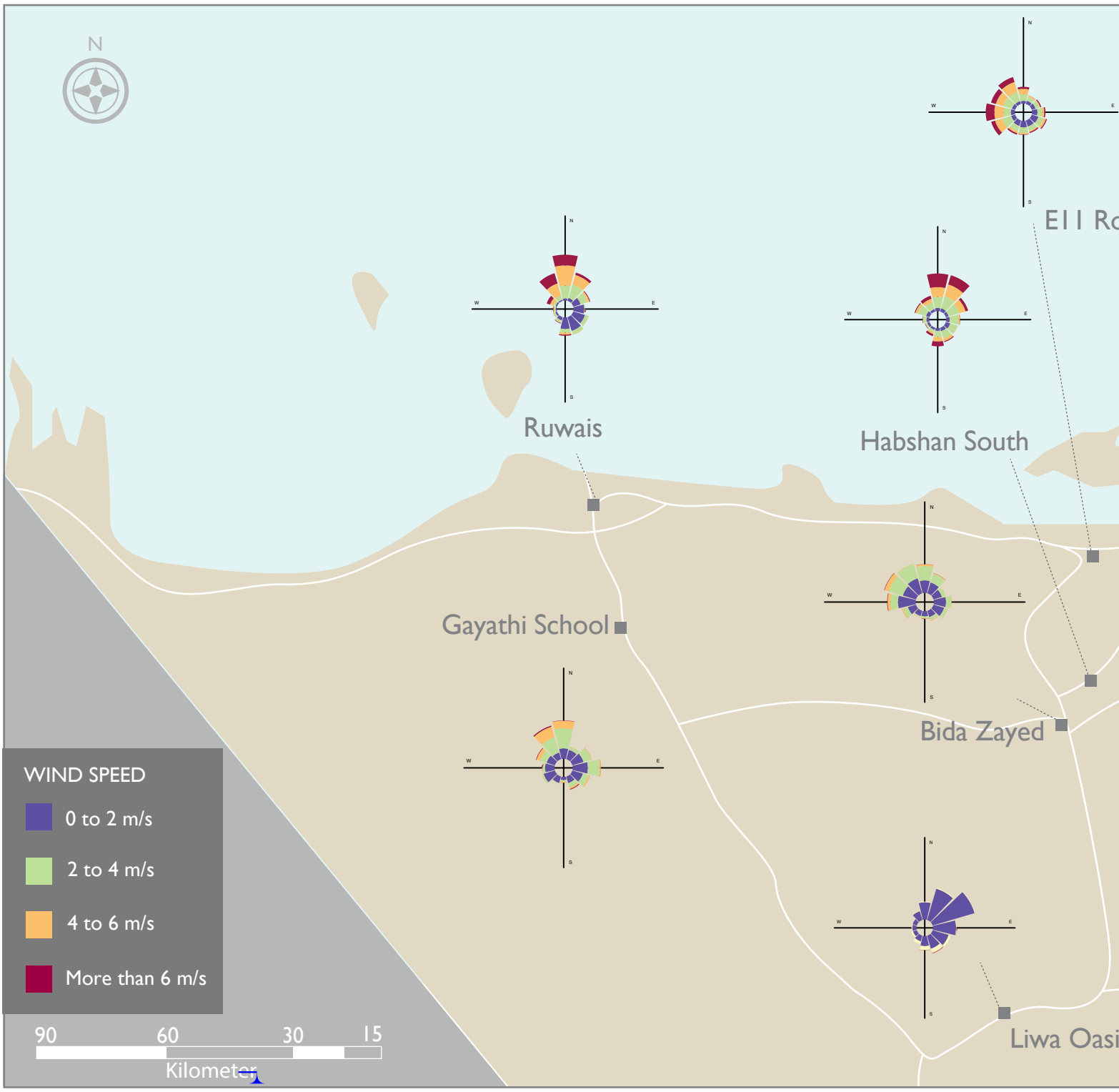
METEOROLOGICAL DATA

All EAD air quality monitoring stations are equipped with sensors to record meteorological parameters, which are essential to understand the ambient air quality patterns and local meteorological conditions. The meteorological parameters measured are: wind speed, wind direction, temperature, relative humidity, net radiation and barometric pressure.

The prevailing winds over Abu Dhabi are northwesterly winds, though differences in wind speed and wind direction may occur in specific locations due to local conditions and patterns. During the night, wind blowing from south-southeast also has a high percentage of occurrence.

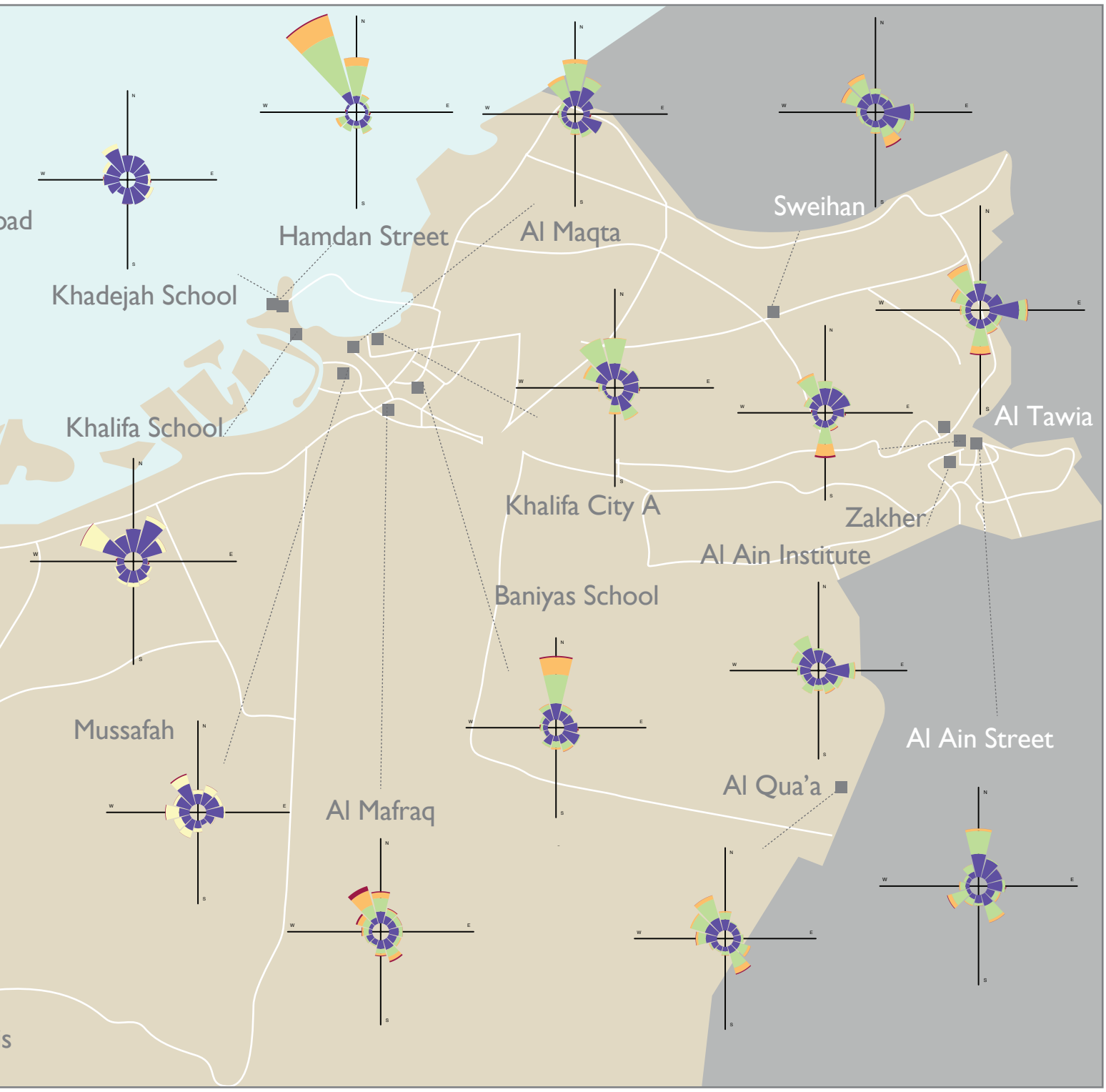
The below map shows the wind roses in all of Abu Dhabi stations from 2007 to 2020, and the wind rose is a graphic tool used to describe the distribution of the wind speed and wind direction in a particular location. The frequency of the winds is plotted by wind direction, with colour bands showing wind speed ranges. The direction of the longest spoke shows the predominant wind direction in that location.

WIND SPEED/DIRECTION DATA IN ABU



07

DHABI STATIONS FROM 2007 TO 2020



08 PARTICULATE MATTER PM_{10}

Figure 1 shows the annual average PM_{10} concentrations by region together with the linear regression of PM_{10} annual means measured at all stations from the beginning of 2007 until the end of 2020.

Overall, there was a slight decrease in the trend of PM_{10} concentrations from the beginning of 2007 until the end of 2020. During 2020, PM_{10} concentration increased in both of Abu Dhabi indusrtrial areas and Abu Dhabi Region, while stable at Al Dhafra Region and decreased at Al Ain Region. In Abu Dhabi Region the lowest concentration of PM_{10} recorded by Hamdan Street station, in Al Ain Region recorded by Sweihan station, and in Al Dhafra Region recorded by Liwa Oasis station.

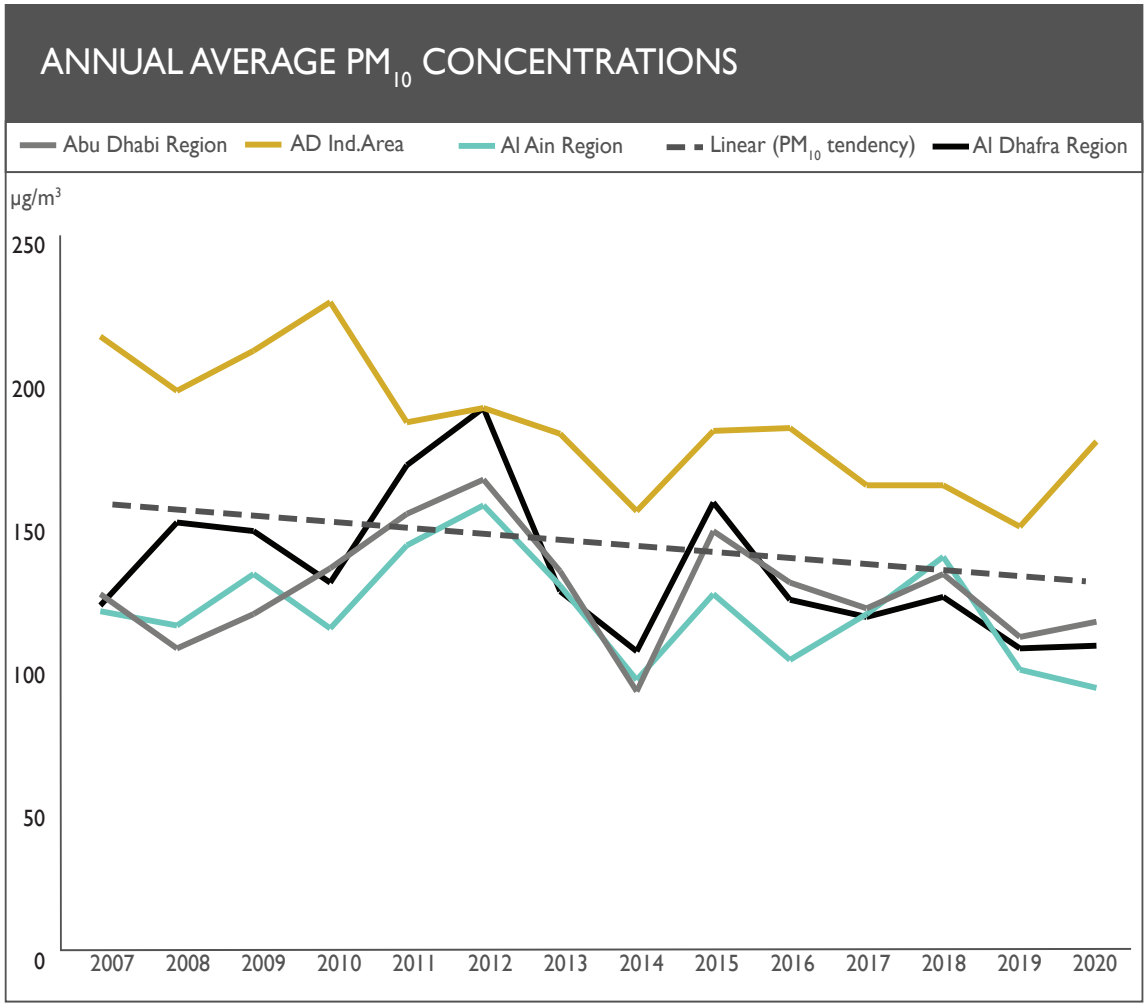
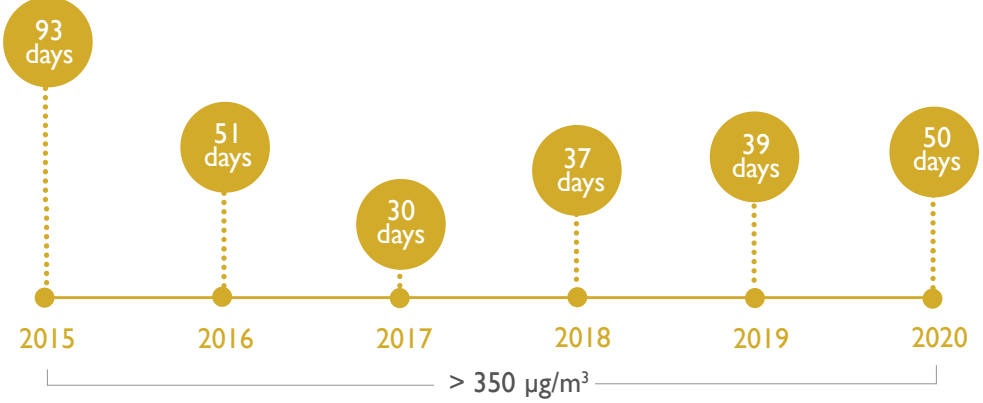


Figure 1:

Averages of the annual average concentrations of PM_{10} given for the sites in Al Dhafra Region, Al Ain Region, Abu Dhabi Region, and Abu Dhabi Industrial Areas. The overall Abu Dhabi Emirate PM_{10} trend (linear regression) from 2007 to 2020 is shown as the dotted line.
Averages were above 350 µg/m³ are:



09 PARTICULATE MATTER $PM_{2.5}$

Figure 2 shows the annual average $PM_{2.5}$ concentrations by region together with the linear regression of $PM_{2.5}$ annual means measured at all stations from the beginning of 2012 until the end of 2020.

Overall, there was a very slight decrease in the trend of $PM_{2.5}$ concentrations from the beginning of 2012 until the end of 2020. During 2020, $PM_{2.5}$ concentration slightly decreased in all region except in Abu Dhabi Region. In Abu Dhabi Region the lowest concentration of $PM_{2.5}$ recorded by Khalifa City A station, in Al Ain Region recorded by Al Tawia station, and in Al Dhafra Region recorded by Liwa Oasis Station.

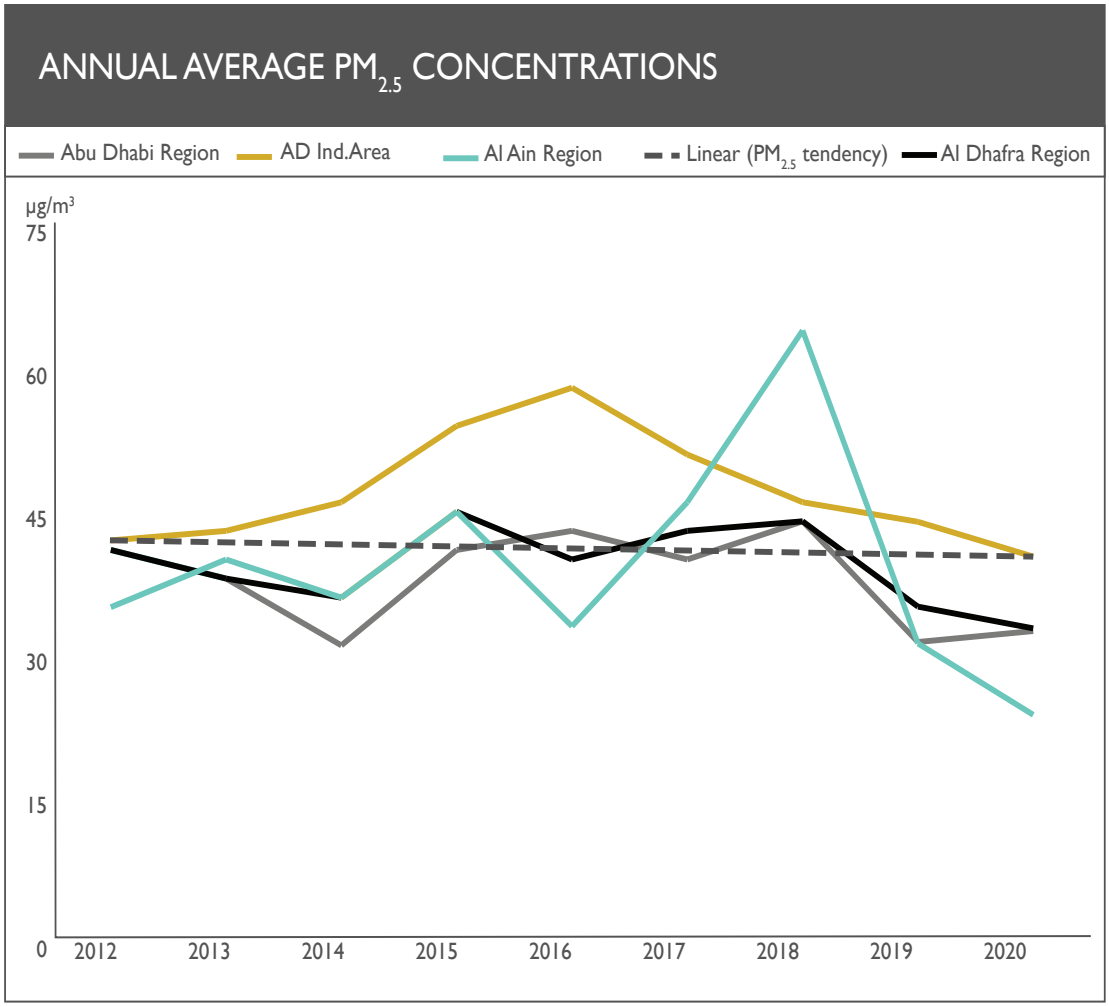


Figure2:

Averages of the annual average concentrations of $PM_{2.5}$ given for the sites in Al Dhafra Region, Al Ain Region, Abu Dhabi Region, and Abu Dhabi Industrial Areas. The overall Abu Dhabi Emirate $PM_{2.5}$ trend (linear regression) from 2012 to 2020 is shown as the dotted line.

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OZONE O_3

Figure 3 shows the annual average O_3 concentrations by region together with the linear regression of O_3 annual means measured at all stations from the beginning of 2007 until the end of 2020.

Overall, there was a notable increase in the trend of O_3 concentrations from the beginning of 2007 until the end of 2020. During 2020, O_3 concentration decreased in all regions. In Abu Dhabi Region the lowest concentration of O_3 recorded by Baniyas School station, in Al Ain Region recorded by Al Ain Islamic Institute station, and in Al Dhafra Region recorded by Bida Zayed Station.

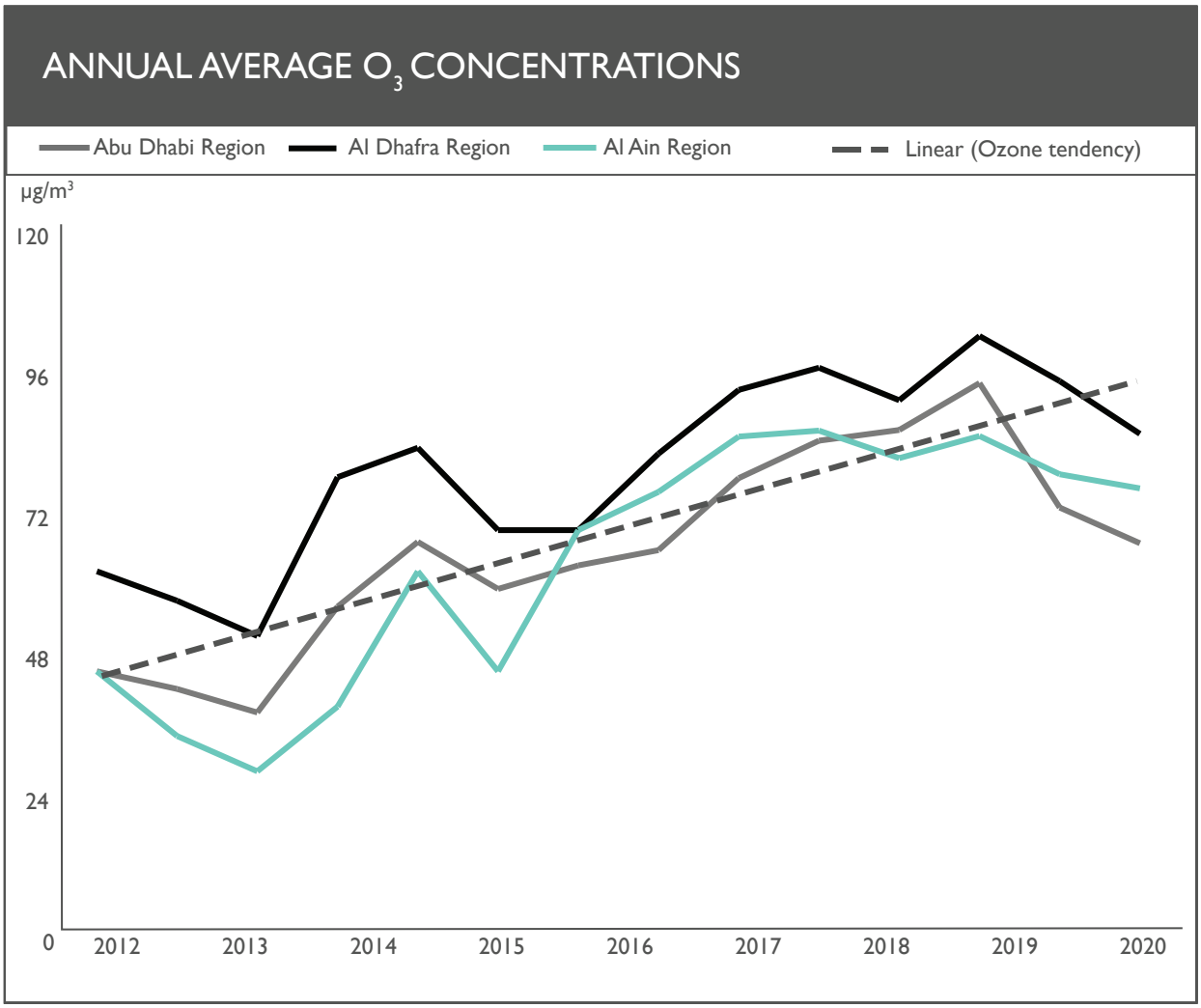


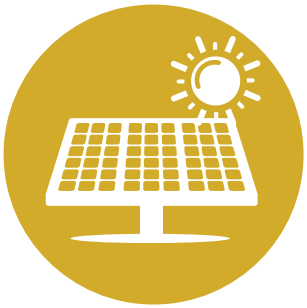
Figure3:

Averages of annual average concentrations for O_3 given for the sites in the Al Dhafra Region, Al Ain Region, and Abu Dhabi Region. A total Abu Dhabi Emirate trend for O_3 (linear regression) from 2007 to 2020 is presented as the dotted line.

O_3 TREND

Ozone trend can be related to the following factors:

DECREASE



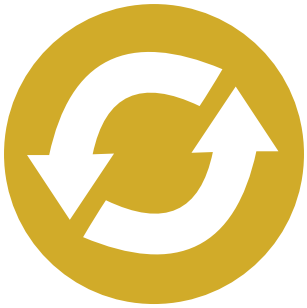
Expand the use of renewable energy(*e.g.* solar energy) to reduce greenhouse gases.

Apply the best available technologies to control emissions.

Encourage the use of international best practices to minimise emissions.

INCREASE

An Increase of traffic and industrial activities.



Effect of global atmospheric circulation.

Climate change increasing global temperature leading to higher potential for O_3 generation

SULFUR DIOXIDE SO_2

Figure 4 shows the annual average SO_2 concentrations by region together with the linear regression of SO_2 annual means measured at all stations from the beginning of 2007 until the end of 2020.

Overall, there was an increase in the trend of SO_2 concentrations from the beginning of 2007 until the end of 2020. During 2020, SO_2 concentration decreased in all regions except Abu Dhabi Industrial Areas. In Abu Dhabi Region the lowest concentration of SO_2 recorded by Khalifa City A Station, in at Abu Dhabi industrial areas recorded by Al Ain Islamic Inst. Station and in Al Dhafra Region recorded by Liwa Oasis Station.

ANNUAL AVERAGE SO_2 CONCENTRATIONS

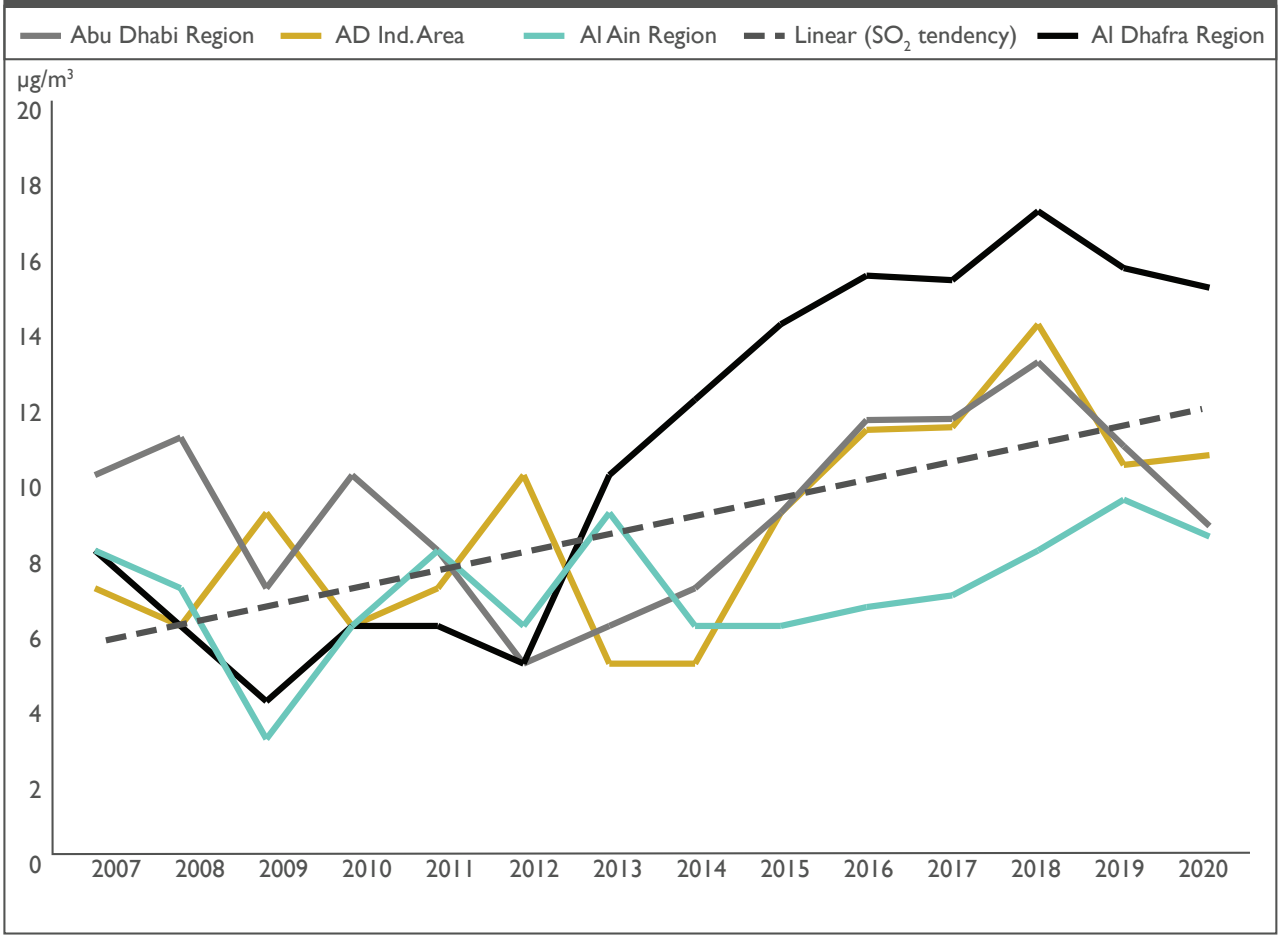


Figure 4:

Averages of annual average concentrations for SO_2 given for the sites in the Al Dhafra Region, Al Ain Region, Abu Dhabi Region, and Abu Dhabi Industrial Areas. A total Abu Dhabi Emirate SO_2 trend (linear regression) from 2007 to 2020 is presented as the dotted line.

12 NITROGEN DIOXIDE NO_2

Figure 5 shows the annual average NO_2 concentrations by region together with the linear regression of NO_2 annual means measured at all stations from the beginning of 2007 until the end of 2020.

Overall, NO_2 concentrations trend had a very slight decrease from the beginning of 2007 until the end of 2020. During 2020, NO_2 concentration slightly decreased in all regions except Al Dhafra Region which constant. In Abu Dhabi Region the lowest concentration of NO_2 recorded by Khalifa City A Station, in Al Ain Region recorded by Al Qua`a Station, and in Al Dhafra Region recorded by Liwa Oasis Station.

The annual average NO_2 concentrations reached 124 % at Hamdan Street station, 115 % at Mussafah station, and 113 % at Al Mafraq station of the annual WHO 2005 guideline value.

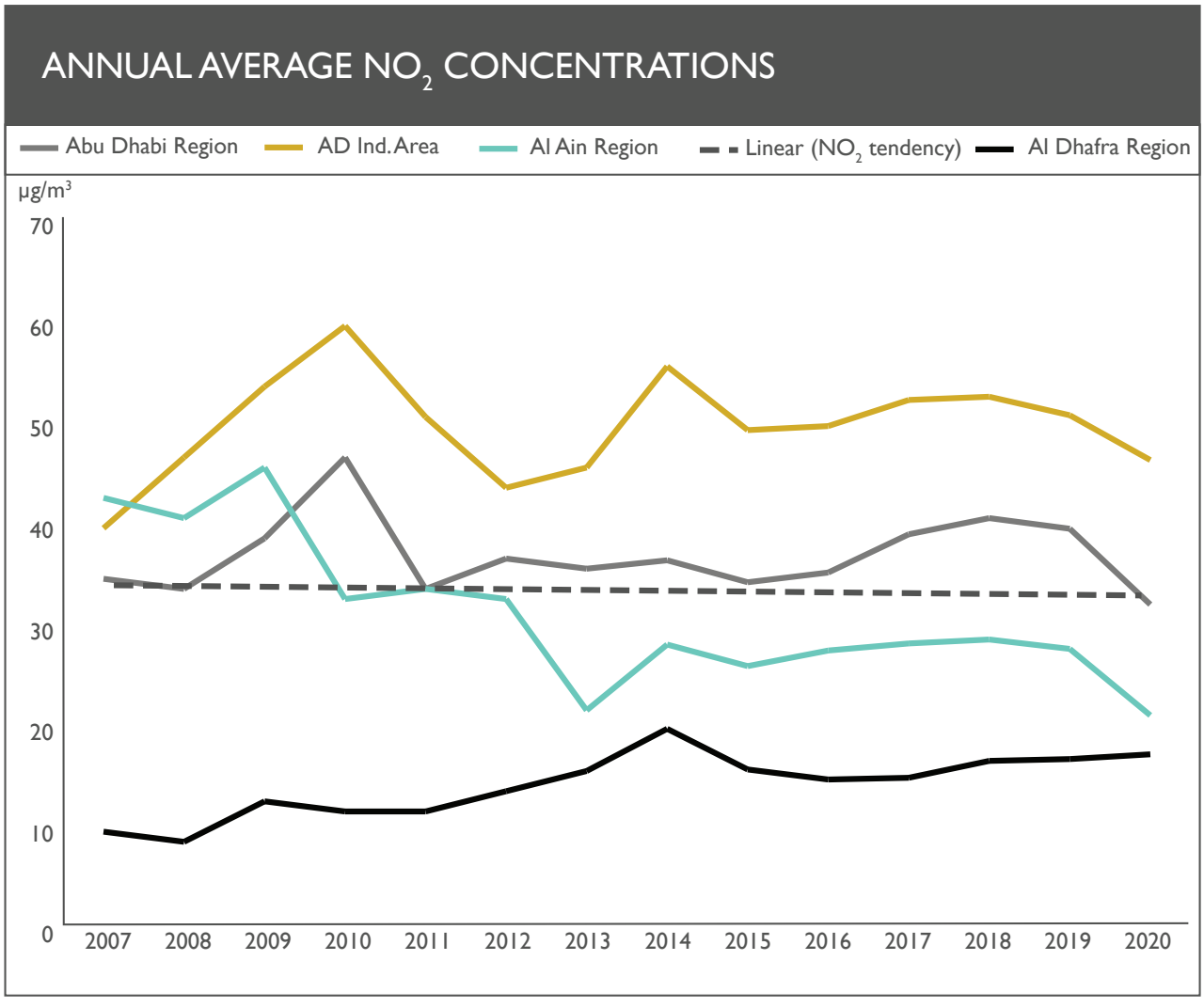


Figure 5:

Averages of annual average concentrations for NO_2 given for the sites in the Al Dhafra Region, Al Ain Region, Abu Dhabi Region, and Abu Dhabi Industrial Areas. A total Abu Dhabi Emirate NO_2 trend (linear regression) from 2007 to 2020 is presented as the dotted line.

13 CARBON MONOXIDE CO

Figure 6 shows the annual average CO concentrations by region together with the linear regression of CO annual means measured at all stations from the beginning of 2007 until the end of 2020.

Overall, there was a decrease in the trend of CO concentrations from the beginning of 2007 until the end of 2020. During 2020, CO concentration decreased in all regions except Al Ain Region which constant and CO concentrations never exceeded any of the air quality limit value in the same year.

ANNUAL AVERAGE CO CONCENTRATIONS

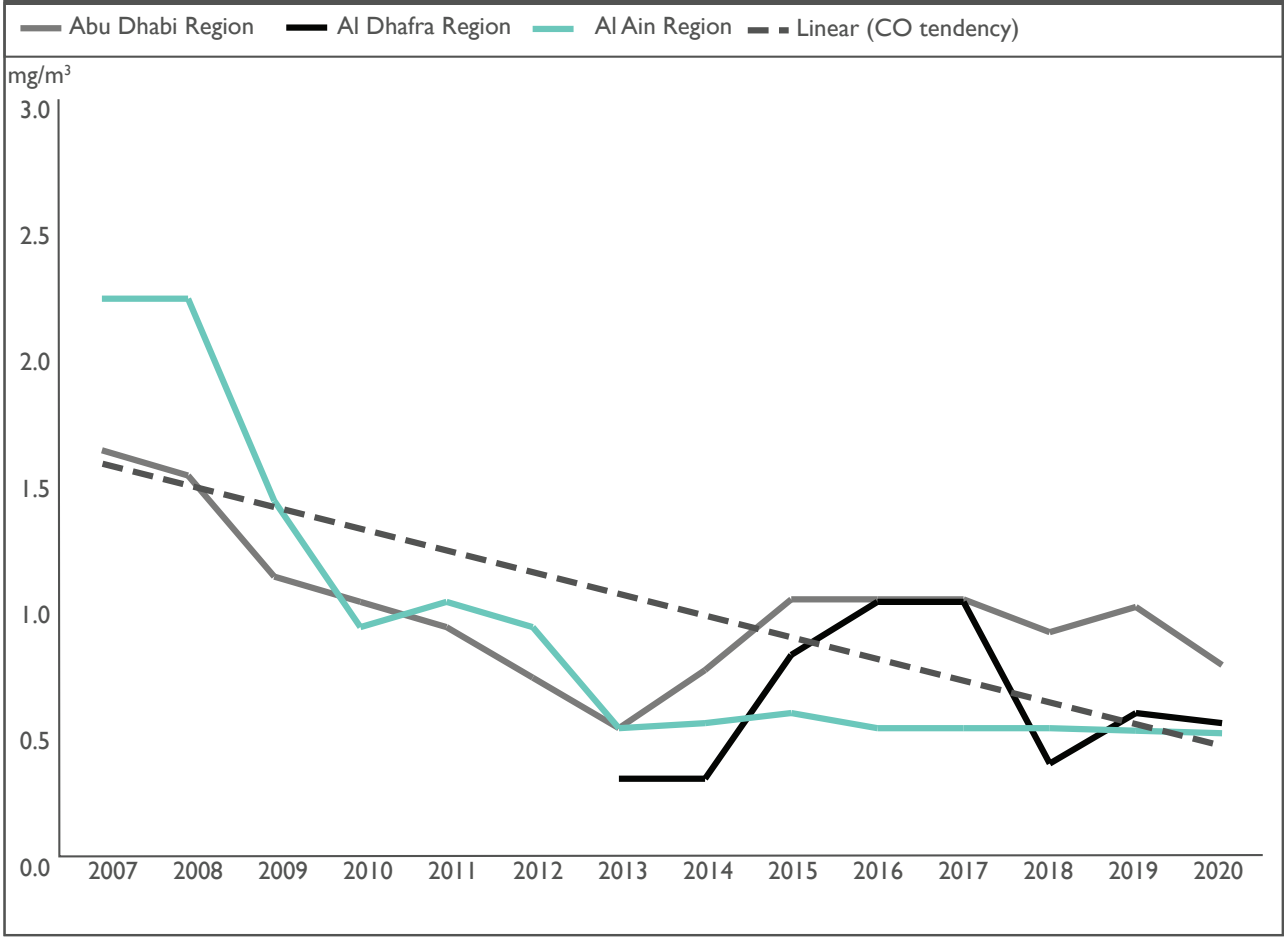


Figure 6 :

Averages of annual average concentrations for CO given for the sites in the Al Dhafra Region, Al Ain Region, and Abu Dhabi Region. A total Abu Dhabi Emirate trend (linear regression) for all stations from 2007 to 2020 is presented as the dotted line.

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HYDROGEN SULFIDE H_2S

There is no air quality limit value for H_2S in UAE. H_2S is not one of the criteria pollutants, but may cause odour nuisance at concentrations far below those that cause health hazards. The World Health Organization has presented a 24 hour average guideline value of 150 µg/m^3. Half-hour average concentrations exceeding 7 µg/m^3 are likely to produce odour problems and complaints among persons exposed.

The WHO guideline given for 24-hour average concentration of H_2S at 150 µg/m^3 was never exceeded.

In Abu Dhabi Emirate H_2S concentrations are well within the health threshold recommended by WHO. However, there has been as increase in H_2S concentrations in some specific area, which may cause odour nuisances.

IMPACT OF COVID -19 ON AIR QUALITY

EAD data confirms that the preventive measures to control the coronavirus pandemic had a huge impact on air pollution, largely due to the reduction in traffic and other human activities.

ELECTRICITY DEMAND REDUCED DURING LOCKDOWN

Data and analysis provided by Department of Energy (DOE) revealed a reduction of approximately 10 % in electricity production during lockdown, mainly attributed to lower commercial and industrial electricity demand. However, data from the last quarter of 2020 showed that the power demand recovered to original Pre-COVID values.

REDUCTION OF ROAD TRANSPORT MOBILITY DURING 2020

Data received from the Integrated Transport Center (ITC) shows a large reduction of road transport mobility since the start of the pandemic, and a slow recovery as soon as the stricter restrictions were lifted.

The COVID-19 health and safety preventative measures have been the main drivers of change during the period. Schools were closed for spring break and then e-learning started on 8 March 2020. Workplaces reduced staff numbers on site to essential workers, and personal trips were limited to essential trips only.

The subsequent gradual easing of COVID-19 health and safety preventative measures has been reflected by the same gradual increase in traffic through to December 2020.

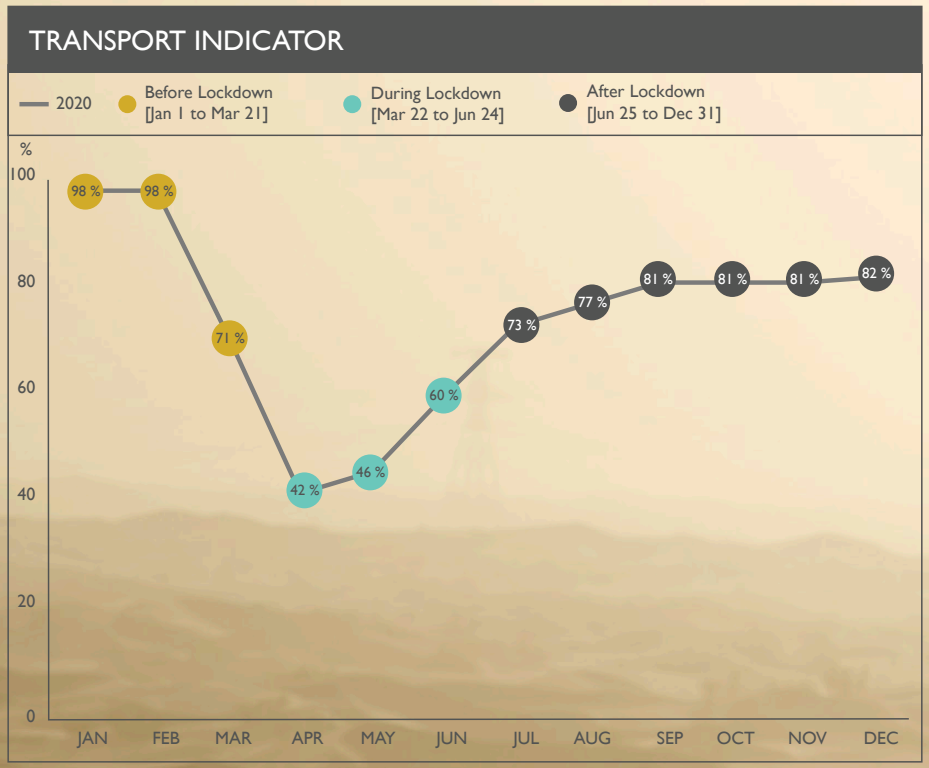

Figure 7 :

Transport Indicator - Indexed weekly counts across the 4 bridges to/ from Abu Dhabi Island. Percentages show the variation compared to before lockdown values.

Source: EAD with data received from Integrated Transport Center (ITC).

OIL AND GAS: NO MAJOR OPERATIONAL CHANGES IN 2020, BUT LOWER EMISSIONS COMPARED TO 2019

Analysis provided by ADNOC confirmed that there were no major operational changes due to the COVID-19 preventive measures. However, according to the initial data available, there was an overall emissions reduction in 2020 when compared to 2019.

AIR POLLUTION LEVELS REDUCED DURING LOCKDOWN, HOWEVER, INCREASED AFTER STRICT RESTRICTIONS WERE LIFTED

EAD data shows a large reduction of nitrogen dioxide (NO_2) during the National Sterilisation Programme, that was in place between March 26 until June 24. Levels of NO_2 continued in low levels during July and August. However, a gradual increase was recorded after September 1, when schools reopened and a gradual ease of preventive measures was set in place.

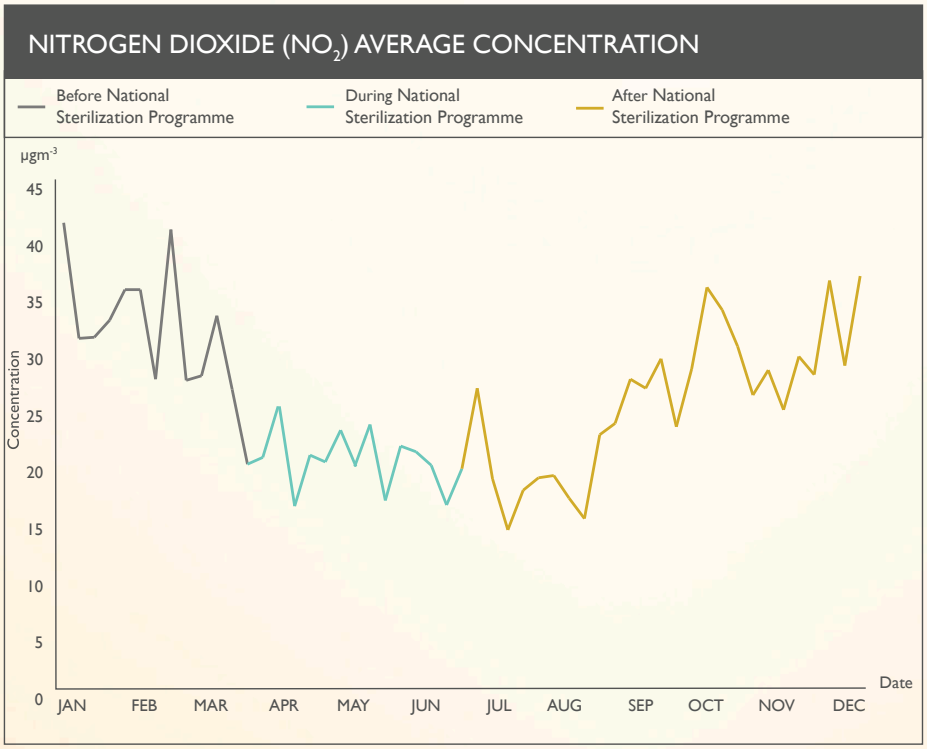

Figure 8 :

Nitrogen dioxide (NO_2) average concentration of all EAD Air Quality Monitoring Stations in 2020.

Large decreases have also been monitored during lockdown for other pollutants related to road transport, such as carbon monoxide (CO) and benzene (C_6H_6).

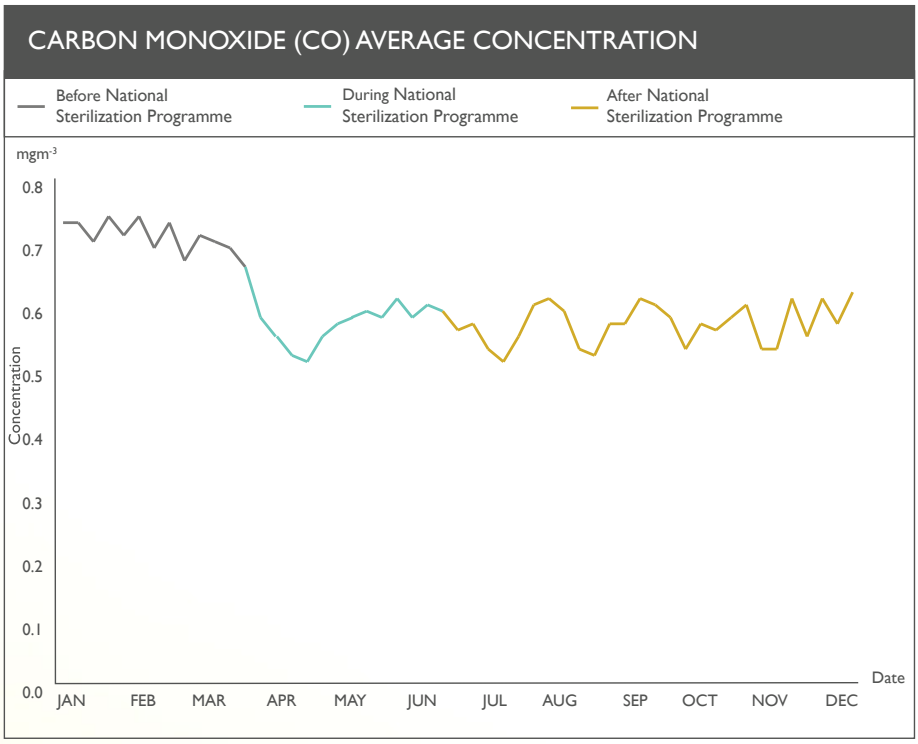

Figure 9 :

Carbon monoxide (CO) average concentration of all EAD Air Quality Monitoring Stations in 2020.

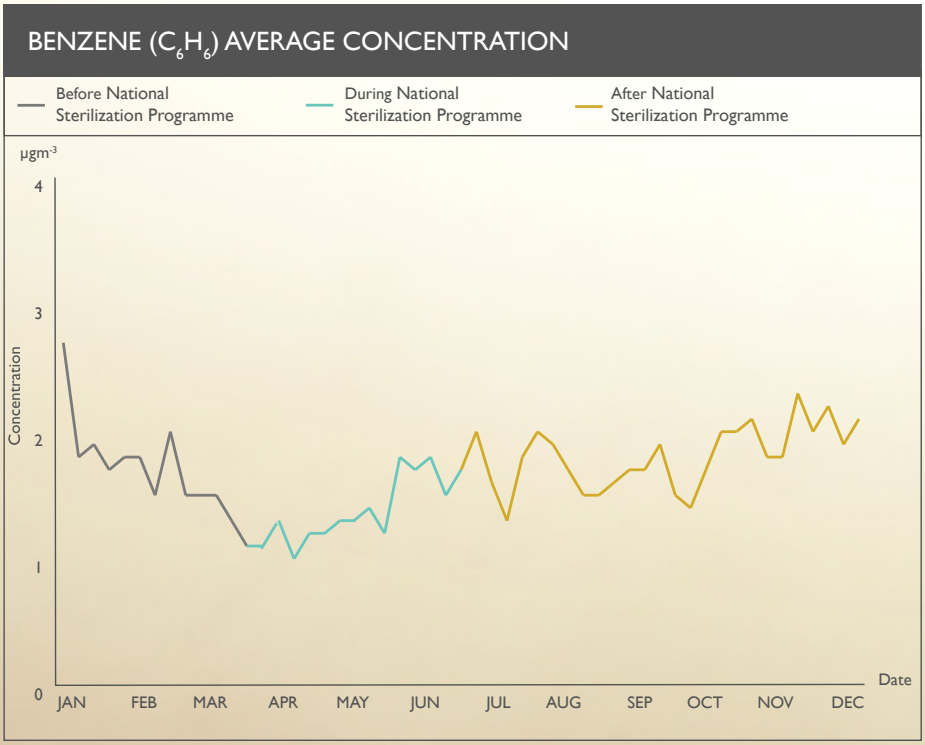

Figure 10 :

Benzene (C_6H_6) average concentration of all EAD Air Quality Monitoring Stations in 2020.

Particulate matter concentrations have a large influence from meteorology and natural dust events. The changes in PM_{10} and $PM_{2.5}$ concentrations cannot be scientifically attributed to the COVID-19 preventive measures at this stage. Further analysis and research are ongoing to understand the influence of the local emissions and regional events during this period.

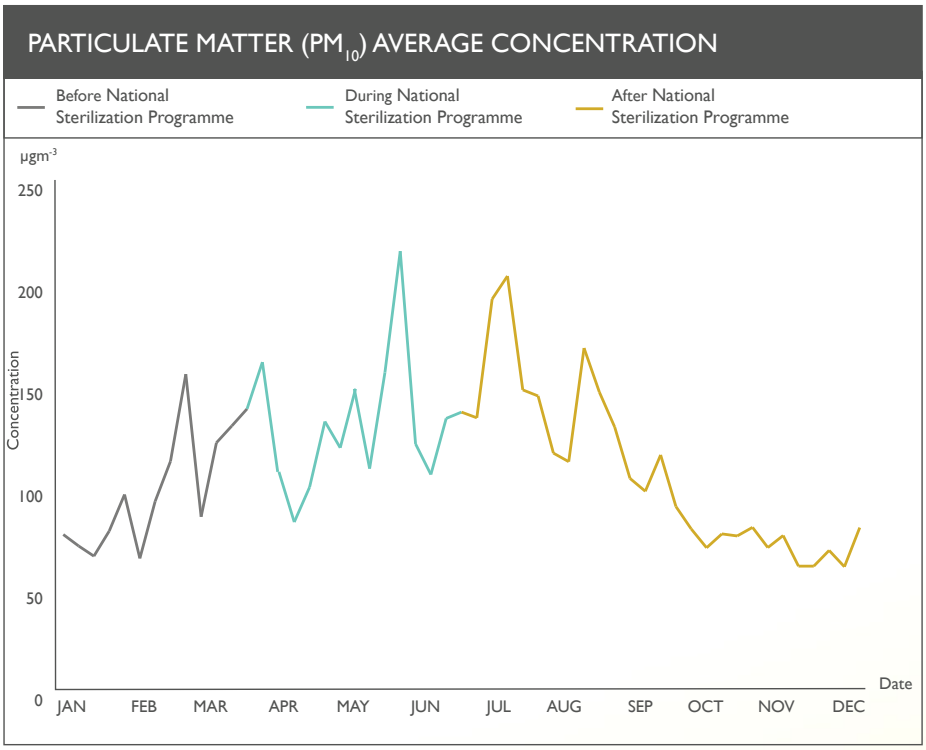

Figure 11 :

Particulate matter (PM_{10}) average concentration of all EAD Air Quality Monitoring Stations in 2020.

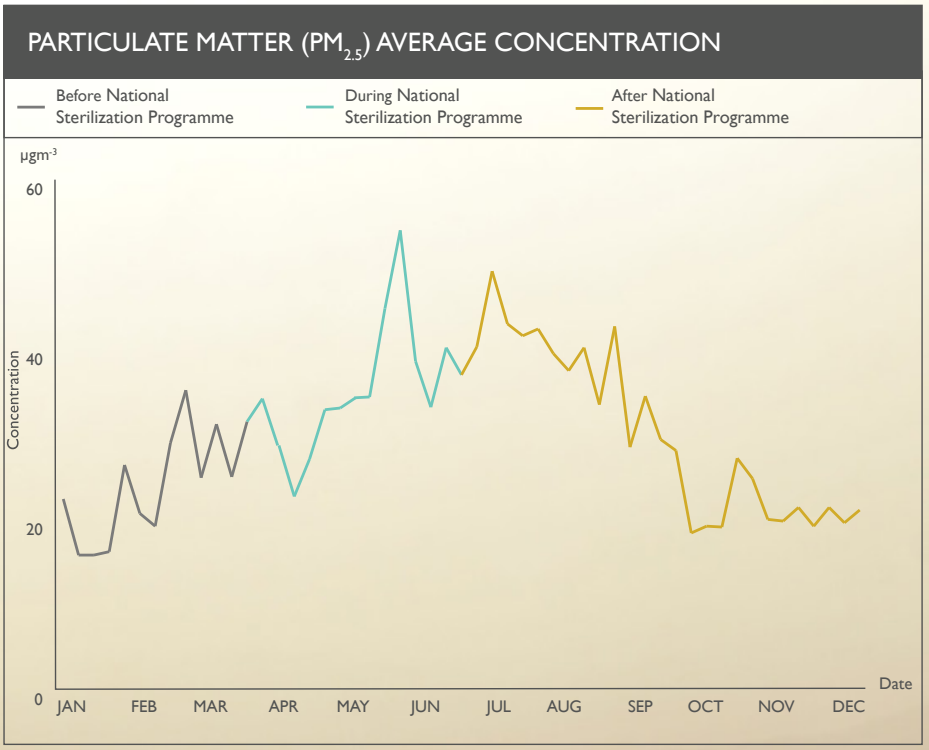

Figure 12 :

Particulate matter ($PM_{2.5}$) average concentration of all EAD Air Quality Monitoring Stations in 2020.

Sulfur dioxide (SO_2) concentrations monitored in Abu Dhabi emirate did not have a drastic reduction during lockdown. However, a deeper analysis shows that SO_2 concentrations were lower than the values monitored during the previous 3 years (2017-2019). It is important to understand that in Abu Dhabi SO_2 is a pollutant largely influenced by oil and gas activities. ADNOC confirmed to EAD that there had not been any major operational changes due to COVID-19, which may explain the SO_2 values monitored during lockdown.

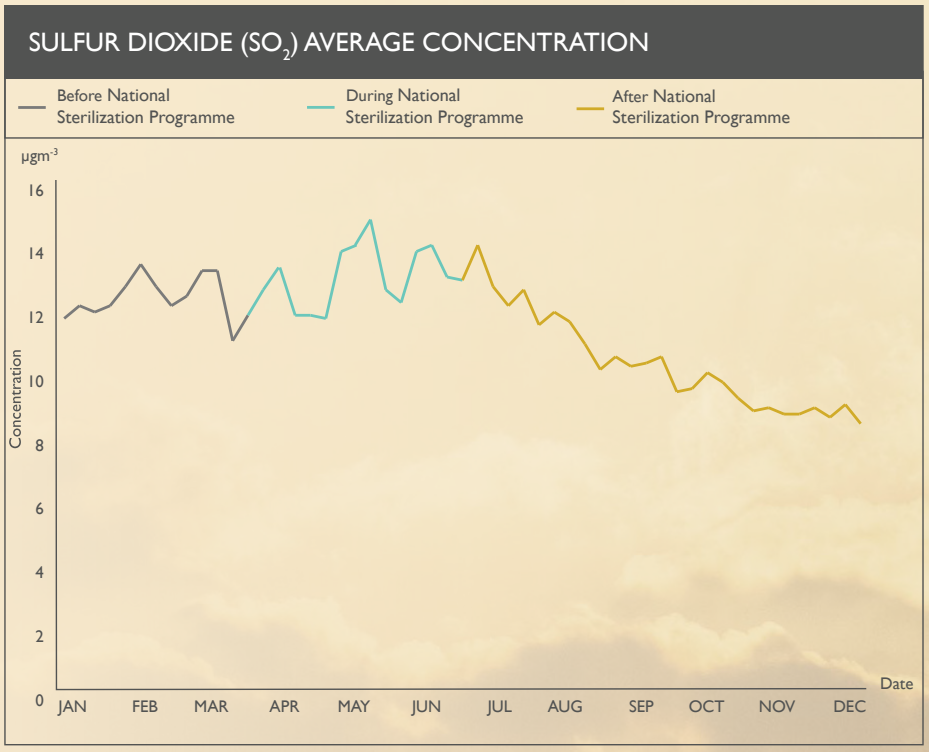

Figure 13 :

Sulfur dioxide (SO_2) average concentration of all EAD Air Quality Monitoring Stations in 2020.

Ozone is a secondary pollutant, formed in the atmosphere by the reaction of NOx and VOCs in the presence of sunlight. An initial decrease of ozone was observed after the preventive measures were initiated. However, an increase of ozone levels was observed starting from May until September. Even though these increases may seem counterintuitive, it is a consequence of the complex ozone chemical formation. Similar episodes have been reported in Barcelona (A. Tobías et al. 2020), India (Sharma et al., 2020) and London during the COVID-19 lockdowns. Also, it is known that the increase of sunlight in the summer months increases the production of ozone, which explains the high values measured during July and August. Further analysis is available in Teixido et al. 2021.

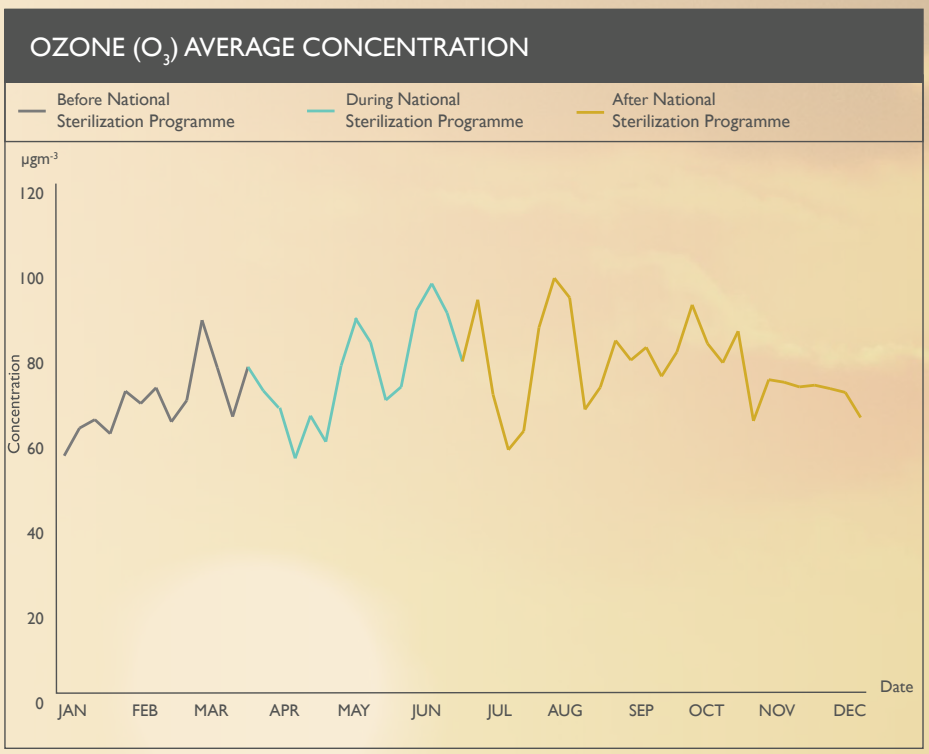

Figure 14 :

Ozone (O_3) average concentration of all EAD Air Quality Monitoring Stations in 2020.

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CONCLUSION

Natural and man-made activities are the main contributors to the air quality of Abu Dhabi. Our desert environment plays an important role in quality of the air as well. As our population grows, our contribution to the level of air quality will get affected.

To sum up, compared to the previous year, 2020 show a decrease in the average of O_3 concentration at all regions, $PM_{2.5}$ concentration also decreased at all regions except at Abu Dhabi Region, and PM_{10} concentration increased at all regions. However SO_2, NO_2 and CO were compliant in all the stations.

Photo credit: **Environment Agency - Abu Dhabi**

CONTACT US

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