

ARAB ENVIRONMENT IN 10 YEARS



2017 Report of the Arab Forum for Environment and Development

AIR POLLUTION

Prof. Farid B. Chaaban



Introduction

- The impact of fuel combustion in various anthropogenic activities is proven to have detrimental effects on air quality,
- Air quality degradation is regarded as one of the most serious environmental risks.
- **Overall annual cost of air quality degradation:**
 - **around 2% of GDP in developed countries and,**
 - **around 5% in developing countries.**
- These costs include mortality, chronic illnesses, hospital admissions, lower worker and agricultural productivity, IQ loss, and reduction of visibility.
- To assess variations and trends, current data will be compared to those published in the AFED report of 2008.



Global View- Organization for Economic Co-operation and Development (OECD),

The global costs of air pollution:

- Premature deaths: USD 3 trillion in 2015 and projected to increase to USD 18-25 trillion in 2060.
- Suffering and illnesses, including restricted activity and hospital admissions: USD 300 billion in 2015 and will increase to around USD 2.2 trillion in 2060.
- Hospital admissions: 3.6 million in 2010 and expected to increase to around 11 million in 2060.



Global View- World Bank

Global Emissions Data Related to CO₂ and PM_{2.5}

Year	CO ₂ [metric tons/capita]	Population exposed to PM _{2.5} levels exceeding WHO guidelines [%]	Average PM _{2.5} Exposure [µg/m ³]
1995	4.1	95.8	38.0
2000	4.0	95.3	38.9
2005	4.5	94.6	40.2
2010	4.8	91.7	40.2
2013	5.0	92.2	42.4

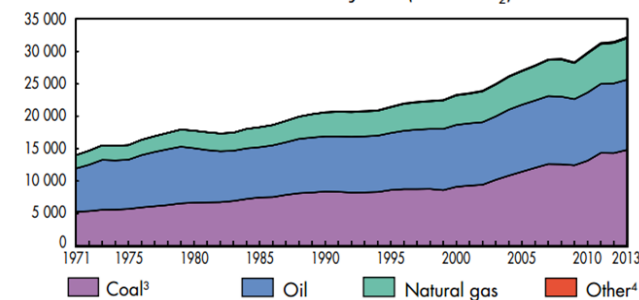
World CO₂ emissions from fuel combustion

1973-2013

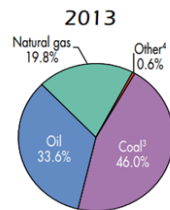
International Energy Agency

CO₂ Emissions by fuel

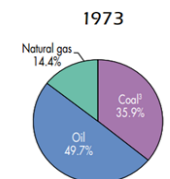
World¹ CO₂ emissions from fuel combustion² from 1971 to 2013 by fuel (Mt of CO₂)



1973 and 2013 fuel shares of CO₂ emissions from fuel combustion²



32 190 Mt of CO₂



15 515 Mt of CO₂

OnlyZeroCarbon.org

IEA Key World Energy Statistics 2015

Regional Trends

- Annual premature deaths from exposure to PM10 in the Arab region is around 300 per one million inhabitants, and could rise to 500-600 per million by 2060.
- Several Arab countries have witnessed major political, social and economic turmoil accompanied by major shifts in the energy production and consumption.
- **Natural sources of air pollution are frequent in the region**



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Per capita CO₂ emissions [metric tons/year]- World Bank

Country	2007	2013	% Change
Algeria	3.2	3.5	9.4
Bahrain	23.7	26	9.7
Djibouti	0.6	0.7	16.7
Egypt	2.4	2.4	0.0
Iraq	2.2	4.9	122.7
Jordan	3.8	3.4	-10.5
Kuwait	29.6	27.3	-7.8
Lebanon	3.3	4.3	30.3
Libya	8.3	8.1	-2.4
Mauritania	0.6	0.7	16.7
Morocco	1.6	1.8	12.5
Oman	16.8	15.7	-6.5
Qatar	53.7	40.5	-24.6
Saudi Arabia	14.9	17.9	20.1
Somalia	0.1	0.1	0.0
Sudan	0.3	0.3	0.0
Syria	3.4	1.9	-44.1
Tunisia	2.4	2.5	4.2
United Arab Emirates	22.6	18.7	-17.3
Yemen	1.0	1.0	0.0
Regional Average	9.73	9.09	-6.6
World Average	4.66	5	7.3



The Regional Power Sector- ESCWA-OAPEC

- Sharp increase in electricity consumption during the last 40 years.
- Around 94% of electricity generation has largely relied on oil and gas.
- Hydropower and other renewable sources: only 5.7%, mostly hydro.
- Short, medium and long terms strategies have been successfully implemented in many countries to improve the energy access.
 - In Saudi Arabia, the percentage of the population connected to the grid increased from around 41% in 1980 to 99.5% in 2012.
 - Morocco and Tunisia went, respectively, from 45% and 56% in 1980 to 99% and 99.5% in 2012.

P.S. Being connected to the grid is no longer a guaranty of getting undisrupted electrical supply.

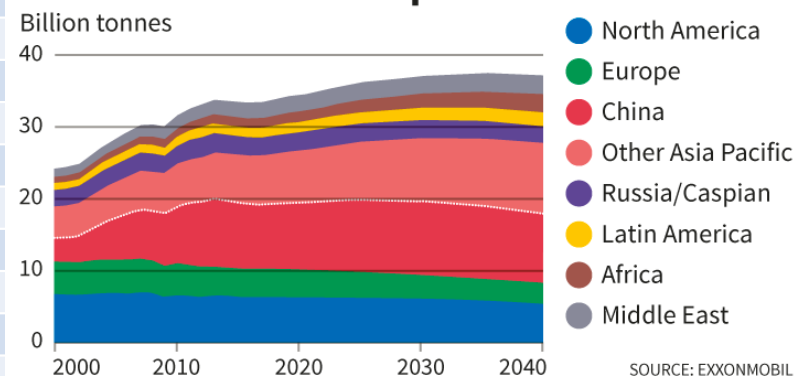


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The Power Sector- substantial increase in CO2 emissions- OAPEC

Country	Electricity Generated [10 ⁶ kWh]		CO ₂ emitted [10 ⁶ tons]		Percentage Change
	2006	2015	2006	2015	
Algeria	35.2	64.66	24.6	45.3	83.7
Bahrain	9.76	17.29	6.8	12.1	77.2
Egypt	108.69	174.87	76.1	122.4	60.9
Iraq	35	91.41	24.5	64	161.2
Jordan	11.63	19.01	8.1	13.3	63.5
Kuwait	41.28	67.92	28.9	47.5	64.5
Lebanon	9.29	11.97	6.5	8.4	28.8
Libya	18.2	37.49	12.7	26.2	106
Mauritania	0.62	0.85	0.4	0.6	37.1
Morocco	19.92	29.92	13.9	20.9	50.2
Oman	12.06	29.13	8.4	20.4	141.5
Qatar	14.03	38.83	9.8	27.2	176.8
Saudi Arabia	181.43	338.33	127	236.8	86.5
Somalia	0.3	0.35	0.2	0.2	16.7
Sudan	4.5	13.05	3.2	9.1	190
Syria	37.73	19.87	26.4	13.9	-47.3
Tunisia	12.27	18.21	8.6	12.7	48.4
UAE	66.77	116.53	46.7	81.6	74.5
Yemen	5.11	5.35	3.6	3.7	4.7
Total	623.79	1,095	436.65	766.53	
Average Increase in CO₂ Emissions					75.5%

...as carbon emissions peak



The Transport Sector- Statistics

Country	Population in 2007	Number of Vehicles per 1000 inhabitants in 2007	Population in 2014	Number of Vehicles per 1000 inhabitants 2014	2014 Ownership Ranking [out of 191 Countries]
Algeria	33,857,913	87	39,666,52	114	100
Bahrain	752,647	322	1,377,240	537	27
Egypt	75,497,914	30	91,508,080	45	131
Iraq	28,993,376	50	36,423,390	50	130
Jordan	5,924,247	47	7,594,550	165	83
Kuwait	2,851,144	357	3,892,110	527	32
Lebanon	4,099,114	434	5,850,740	434	41
Libya	6,160,481	234	6,278,440	290	59
Morocco	31,224,136	53	34,377,510	70	121
Oman	2,595,132	150	4,490,540	215	67
Qatar	840,634	378	2,235,360	532	29
KSA	24,734,532	336	31,540,370	336	51
Somalia	n/a	n/a	10,787,100	3	186
Sudan	n/a	n/a	40,234,880	27	147
Syria	19,928,518	50	18,502,410	73	116
Tunisia	10,327,285	71	11,107,800	125	97
UAE	4,380,439	193	9,156,960	313	55
Yemen	22,389,172	47	26,832,220	35	138



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The Transport Sector- ctd

Gasoline Consumption Trends over the Past Decade

Country	Gasoline consumption [10 ³ barrels/day]		
	2006	2010	2015
Algeria	67.5	88.6	103
Bahrain	11.6	13.8	18
Egypt	72.6	98.1	153
Iraq	100	102.8	105
Jordan	17.3	21	31
Kuwait	51.8	58.9	71
Lebanon	36.5	38.8	41
Libya	57.1	68.2	87
Mauritania	n/a	0.5	0.5
Morocco	n/a	13	14.1
Oman	23.4	27.9	62
Qatar	17.9	28	37
Saudi Arabia	293.6	373.8	559
Somalia	n/a	0.8	0.8
Sudan	n/a	18.1	21.4
Syria	31.8	39.8	27
Tunisia	10.3	11.1	14
United Arab Emirates	79	92	181
Yemen	27.8	34.1	30
Total Arab Countries	898	1096.9	1554.8



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Air Pollution Standards – WHO Guidelines

- Air pollution has globally risen by 8 percent in the past five years, (WHO),
- This will lead to around 3 million premature deaths a year.
- Urban air quality data, collected between 2011 and 2015, reveals that 98% of cities with over 100,000 inhabitants in low- and middle-income countries do not meet WHO air quality guidelines.

WHO Concentration Limits

Pollutant	PM ₁₀	PM _{2.5}	Ozone	NO ₂	SO ₂
Annual mean	20	10		40	
24- hour mean	50	25			20
8- hour mean			100		
1- hour mean				200	
10-minute mean					500



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Air Pollution Levels- MENA Region

- The MENA region and Southeast Asia were the regions that performed **worst** overall according to the WHO database.
- Reports from 3,000 cities indicated that several major Arab cities are amongst the 20 most polluted cities in the world.
 - Riyadh in KSA with PM₁₀ concentrations of around 368ug/m³ ranked 7th,
 - Al Jubail ranked 8th with levels reaching 359.
 - Hamad Town in Bahrain ranked 11th with 318,
 - Dammam 15th with 286, and
 - Maameer 19th with 267.

EPA Air Quality Index	Levels of Health Concern	Cautionary Statements	
		PM _{2.5}	PM ₁₀
0 - 50	Good	None	None
51 - 100	Moderate	None	None
101 - 150	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.	People with respiratory disease, such as asthma, should limit outdoor exertion.
151 - 200	Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid prolonged exertion; everyone else should limit prolonged exertion.	People with respiratory disease, such as asthma, should avoid outdoor exertion; everyone else, especially the elderly and children, should limit prolonged outdoor exertion.
201 - 300	Very Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.	People with respiratory disease, such as asthma, should avoid any outdoor activity; everyone else, especially the elderly and children, should limit outdoor exertion.
301 - 500	Hazardous	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.	Everyone should avoid any outdoor exertion; people with respiratory disease, such as asthma, should remain indoors.

Diesel Sulfur Matrix in the Region

COUNTRY	Diesel Sulfur Content in 2006 (ppm)	Diesel Sulfur Content in 2011 (ppm)	COMMENT
Algeria	900	900	No plans to process crude further
Bahrain	5,000 (500)	500/10	Up to 10ppm for export, 500 ppm for local use
Egypt	5,000	5,000	No plans to reduce levels
Iraq	10,000	10,000	Actual (existing) standard is 25,000 ppm
Jordan	9,000	7,000-10,000	Actual standard is 350ppm, to be reduced to 50ppm after refinery expansion
Kuwait	3,500	2000	50 ppm diesel imported from EU, plans to further drop to 10ppm
Lebanon	6500 (350)	Industrial: 5000 Transport: 500	2 grades marketed, green and red diesel
Libya	1,000	1,000	Standards are about 1,500 ppm
Morocco	10,000 (350)	50	Since 2009 (not 2006)
Oman	5,500	50	Since 2008 (not 2006)
Palestine	10,000	10,000	Gets fuel from Jordan which is at 10,000 ppm
Qatar	5,000	500	Road map to drop to 10ppm by 2012
Saudi Arabia	5,000	500	Gradual drop from 10,000 ppm Effective since 2014
Syria	6,500	6,500	Actual Standards 7,000 ppm Imported 50ppm for selected cities
Tunisia	10,000	50	since 2009 (not 2006)
UAE	5,000	500	Plans to go to 50ppm, implemented only in Dubai
Yemen	10,000	10,000	No current standards. Plans to build a refinery to drop the level

Air Pollution Drop

- Researchers from Germany and KSA has found in 2015 that pollution levels over several major cities in the region are dropping due to economic and political unrest and war.
- Some cities have witnessed declines of 20 to 50%, due to legislation enforced to reduce pollution.
- The power sector condition drastically deteriorated and people opted for distributed small-scale diesel generators to be used during the power cut-off intervals.



Air Pollution Drop- ctd

- A substantial decrease in NO₂ concentrations was reported in Baghdad and central Iraq since 2013, and in Egypt during political unrest of 2011.
- In sharp contrast, the report found a 20-30% increase in NO₂ levels in Lebanon in 2014, which is linked to over 1.5 million Syrian refugees that have moved into the country.
- Drops in pollution levels in other parts of the region, such as KSA, Kuwait and the UAE, are attributed to the introduction of air quality control systems and devices.
- The Middle East air pollution control equipment market was around USD 103.4 million in 2009 reached around USD 155 million by 2014.



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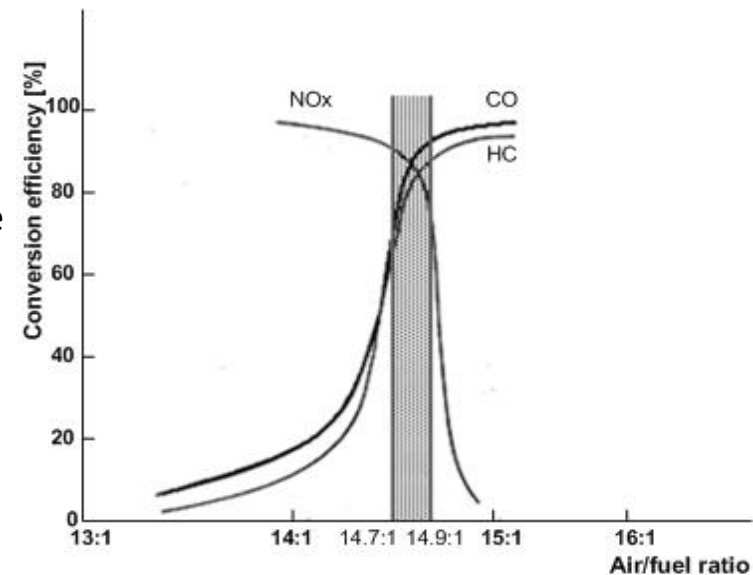
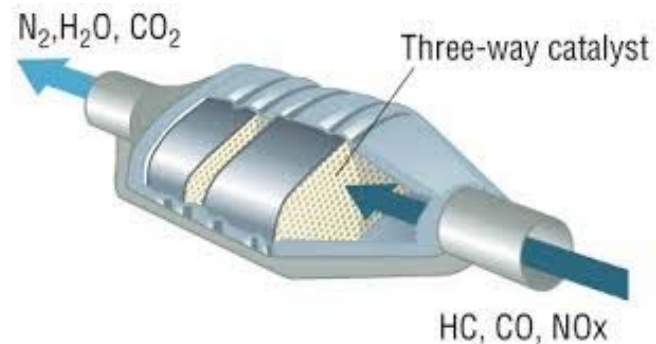
Mitigation Options- The Power Sector

- Considerable potential for renewable energy technologies, stimulated by the rapid drop in their prices, mainly of PV cells.
- Most regional countries including Egypt, Jordan, Lebanon, Mauritania, Morocco, and the UAE are developing a viable market for RE investments.
- Between 2012 and 2015, total renewable installed capacity witnessed a 150% increase, exceeding 3GW, excluding hydropower, compared to 1.2GW in 2012.
- In 2015, renewable power production (including hydropower) contributed to around 6% of the total generation capacity.



Mitigation Options- The Transport Sector

- Most sustainable transportation strategies fall into one of three categories:
 - Vehicle technology changes,
 - Fuel quality,
 - Roads managements. (driving modes)
- The implementation of fuel standards and vehicle inspection measures can be found in most Arab nations, though they are not strictly implemented.
- The implementation of effective mass transport systems can only be found in countries such as Egypt, Algeria, Tunisia, and the UAE.



Conclusions- Recommendations

Two contradicting trends:

1- On one side, mitigation measures such as adopting cleaner fuels for transport and integrating renewable and cleaner fuels technologies in the power sector have led to a **drop in emissions** from these sectors.

2- On the other hand, the demographic and economic growth witnessed in most countries has led to an **increase in demand** for power and motor vehicles.

There is an **overall increase** in fuel combustion and hence GHG emissions in most countries.



Conclusions- Recommendations

- In the Power Sector:

- ✓ **Renewable Energy** technologies for power generation at a much wider scale is very promising.
- ✓ **Energy Efficiency** is also very viable option.



- In the Transport Sector: 3 categories:

- ✓ Vehicle technology.
- ✓ Fuel quality.
- ✓ Driving modes.



- Viable options include hybrid vehicles and modern mass transport.



Thank You



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