

Air Pollution in Qatar: Causes and Challenges

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1. INTRODUCTION

Since the country's independence in 1971, the Qatari economy has witnessed rapid economic growth which led to a continuous improvement of the society well-being. For instance, the level of income per capita (current 2005 US \$) has increased from \$29,914.26 in 2000 to \$93,352.02 in 2013. In terms of education, the net enrolment ratio in primary education has increased from 79.58% to 92.09% between the years 1992 and 2011 (World Bank Indicators, 2015). Moreover, between 1975 and 2014, the life expectancy has increased from 71.1 years to 78.6 years. This improvement in life expectancy at birth is mainly explained by the continuous investment of a substantial amount of resources in the health infrastructure. Qatar has consistently dedicated a minimum of 2% of total GDP into the health sector over the past decade (World Bank Indicators (WBI), 2015). Moreover, according to Alpen Capital (2014), the Qatari spending on health care per capita is the highest in the GCC countries. This overall rise in well-being is mainly attributed to the natural wealth of the oil and gas sector which contributed to 58.3% of the Qatar nominal GDP in 2011 (Qatar Statistics Authority, 2012).

However, despite the improvement in well-being, the rapid and high increase in income per capita has not been attained without costs. Since few decades ago, the small peninsula of Qatar continues to face major challenges that pose a threat to sustaining its rapid prosperity. The most important challenge is that economic growth is majorly driven by hydrocarbon resources, which makes the economy highly vulnerable to fluctuations in oil and gas prices. In addition, the oil and gas production and use are considered as major contributors to the deterioration of the environment. Environment degradation, defined as "the deterioration in environmental quality from ambient concentrations of pollutants and other activities and processes such as improper land use and natural disasters" (United Nations, 1997) is among the most pressing issues in the world. In the last dec-

ades, several initiatives have been developed to identify the most appropriate ways to address the issue of environmental degradation. Qatar has undertaken the responsibility to participate in this global agenda as stated by the environment sustainability pillar of Qatar National Vision (QNV) 2030. However, until now the country's environment indicators are not promising. According to a report by World Wide Fund's Living Planet Report of 2014, if all people on the planet had the footprint of the average resident of Qatar, we would need 4.8 planets. Therefore, major initiatives should be undertaken in order to ensure a real progress toward the environment sustainability pillar as stated by QNV 2030.

Even though environment degradation is a broad concept that covers various areas including land, water and air pollutions, in this white paper we only focus on air pollution for different reasons. First, compared to land and water pollution, air pollution is the main contributor to environmental degradation in Qatar. Moreover, air pollution is actually a major challenge for the state of Qatar especially with the upcoming events such as the world cup 2022 which initiated many projects including the new airport, various stadiums, the metro, hotels and other infrastructure. The implementation of these projects will raise the level of air pollution. Second, air pollution has many adverse impacts on people's health. For instance, air pollution is responsible for 5% of global disease (Wania and Mackay, 1996).

Moreover, it is widely believed that air pollution is the major cause of different respiratory diseases. A recent study on Asthma shows a high prevalence of asthma among Qatari children (Janahi et al., 2006). Furthermore, Bener et al. (2009) have examined the effect of asthma and air pollution on primary school students' attendance between October 2003 and July 2004. Their results show that most of the absenteeism caused by asthma have occurred during spring and autumn where the average of air pollutants was at its peak. This strong evidence suggests that air pol-

lution is an important question of research given its great influence on the Qatari quality of life. Therefore, the main questions of interest for both policymakers and academic researchers are the following:

- Is it possible to improve the environment quality without reducing the economic growth?
- What policies should Qatar take in order to sustain its economic growth without compromising on the environment?

2. AIR POLLUTION IN QATAR

The level of air pollution in Qatar is very alarming as it has frequently exceeded local and international recommended standards. In fact, compared to the world health organization’s (WHO) standards of the 24-hour and annual averages concentration of 50 µg/m³ and 20 µg/m³ for PM10, Qatar’s national air quality standards are far from these values. For instance, the values for PM10 is around 150 µg/m³ for 24 hours average concentration and around 50 µg/m³ for the annual average concentration (see WHO). These high levels have increased the likelihood of diseases related to the respiratory system such as asthma, chronic obstructive pulmonary disease among many others. Air pollution is caused by Greenhouse gas emissions (GHG). GHG are gases that trap heat in the atmosphere and lead to global warming which has many negative consequences. In Qatar, the level of GHG emission is very high when it is measured in per capita basis compared to other countries in the world. For example, Qatar is ranked the first in the world in term of CO₂ emissions per capita (World Bank Indicators, 2011).

In terms of components, Figure 1 shows that in 2012 carbon dioxide (CO₂) was the major contributor to GHG in Qatar with a percentage of 93% of total emissions, followed by methane (CH₄) which accounted for 5 %, and nitrous oxide (N₂O) for 2%.

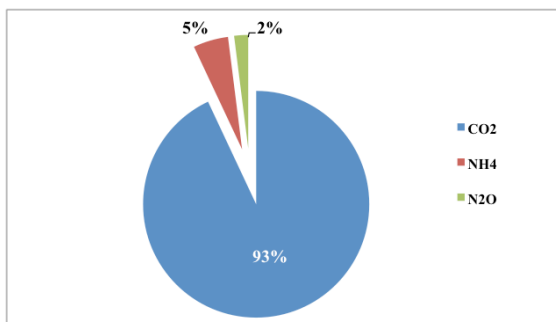


Figure 1: Qatar GHG Emissions by Gas 2012.
World Resources Institute (2012) Climate Analysis Indicators Tool.

The evolution of GHG emissions over the period 1990 to 2012 for Qatar is reported in Figure 2 below. It is clear from figure 2 that there has been a dramatic rise in CO₂ emissions during the last few years. Figure 2 also shows that the contribution of other gases such as CH₄ and N₂O is very minimal and have been steady over the period. As shown by both graphs, CO₂ is the most serious contributor to air pollution in Qatar.

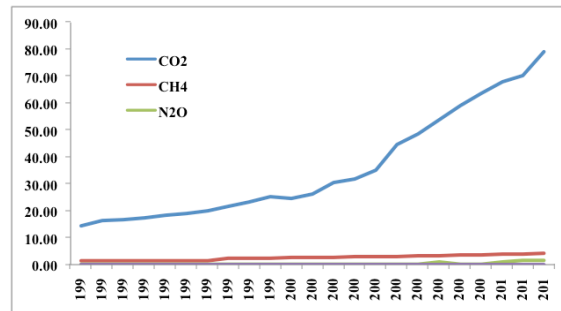


Figure 2: GHG Emissions by Gas (MtCO₂) for the period 1990-2012.
World Resources Institute (2012) Climate Analysis Indicators Tool.

3. SOURCES OF AIR POLLUTION IN QATAR

While all sectors in the Qatar economy contribute to air pollution, Figure 3 shows that energy sector is the principal contributor to GHG emissions with approximately 96% followed by industrial sector 3%, and waste by 1%.

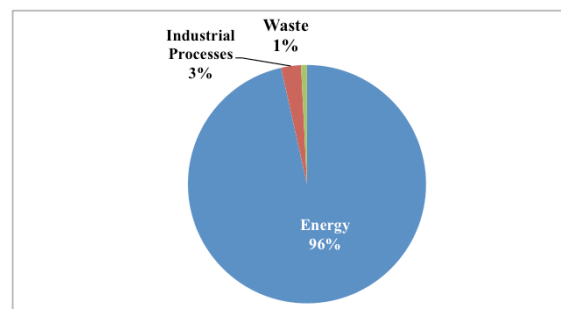


Figure 3: Sources of GHG emission by sector in 2010.
World Resources Institute (2010) Climate Analysis Indicators Tool.

A brief overview of the two major sectors contributing to air pollution is presented below.

3.1 ENERGY SECTOR

The energy sector is the most detrimental to environmental air quality as shown by its significant contribution to GHG emissions. This sector is mainly supported by oil and natural gas and includes companies that play a significant role in supporting the

country's wealth. This includes liquefied natural gas, oil, refining, petrochemical companies and others. Amongst all, natural gas is the most crucial for Qatar; the country is ranked third in the world after Russia and Iran in proven natural gas reserves, and it has been the largest exporter of liquefied natural gas since 2006 with a market share of 31% in 2014 (US Energy Information Administration, A, 2015).

The fact that figure 3 shows that 93% of GHG emissions come from CO₂, then, for the remaining part of this study, it will be more interesting to focus the analysis on CO₂ emissions per capita. The contribution of major energy sub-sectors to CO₂ emissions is reported in Figure 4 below. It shows that the generation of electricity and heat production accounts for the largest portion of energy use in the country. According to World Development Indicators, 100% of Qatar's electricity generation in 2013 came from natural gas. Although natural gas is considered as the cleanest fossil fuel compared to other fuel sources (US Energy Information Administration, B, 2015), it still leads to substantial levels of CO₂ emissions due to the high demand for electricity in the country. In fact, the most extensive user of electricity in Qatar is water desalination plants. For instance, due to scarce water resources in Qatar; 99% of water demand is satisfied by seawater desalination (The Foundation, 2013).

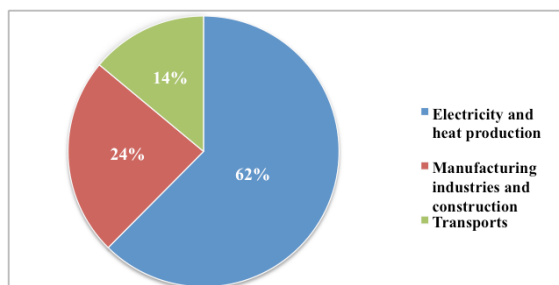


Figure 4: CO₂ Emission by Energy Sub-Sector 2012.

World Bank Indicators.

The two methods Qatar employs to desalinate water are: Multi-Stage Flash (MSF) desalting system and Multi-Effect Thermal Vapor Compression (ME-TVC) (The foundation, 2013). Both methods are energy-intensive and consequently result in a high level of CO₂ emissions. Given the scarce water resources, desalination is highly mandatory to meet the rising population water needs. However, the country is aiming to address this issue by using other more efficient methods for desalination. For instance, Qatar Environment and Energy Research Institute (QEERI), established in 2011 by Qatar Foundation,

invests in research and collaborations to identify the potential of using other methods to desalinate water which could save both energy and environment.

3.2. INDUSTRIAL MANUFACTURING SECTOR

The second contributor to air pollution in Qatar is the industrial process, which contributes up to 3% of total GHG in the country as shown by Figure 3. According to the ministry of environment (2011), industrial processes in Qatar cover four broad areas: mineral production, chemical industry, metal production and other production. GHG emissions are disclosed for each of these four areas and CO₂ is the most significant of all gases. Approximately 81.7% of the total CO₂ emissions come from chemical processes.

4. QATAR ENVIRONMENTAL SUSTAINABILITY CHALLENGES

4.1. TRADE-OFF BETWEEN ENVIRONMENTAL QUALITY AND ECONOMIC GROWTH

Balancing economic growth and environmental quality constitutes the major challenge for Qatar when addressing the issue of environment degradation. This is due to the high reliance of the Qatari economy on hydrocarbon resources and the high contribution of the energy sector to environment degradation. Therefore, one could suggest reducing energy consumption by imposing conservation policies to reduce environment degradation. However, there is a substantial contribution of the energy sector to economic growth. Thus, there is a possible trade-off, since imposing energy conservation policies could improve environmental quality at the expense of economic growth. Ensuring the well-being of the society necessitates that both economic prosperity and environmental quality are attained, thus before policy makers can impose policies to protect the environment they must evaluate what will be the effect of conservation policies on economic growth. Addressing this issue has been deeply examined in the two studies of Charfeddine (2016) and Charfeddine et al. (2016). These studies use recent development of econometrics techniques to examine the causal relationship between energy consumption and economic growth. The authors found evidence of both bidirectional causality and unidirectional causality running from energy consumption to economic growth. Both empirical findings indicate that conservation policies are highly likely to undermine economic growth which means that policymakers should find some other policies that can balance be-

tween economic growth and environmental degradation. Therefore, energy efficiency measures and the use of renewable sources are recommended as suitable alternatives to address the issue of environment degradation.

4.2. LIMITATIONS TO DIVERSIFY AWAY FROM FOSSIL FUELS

Given the reliance on fossil fuel, diversification of Qatar's economy will allow the country not only to reduce the vulnerability of its economic growth but also to reduce the burden on the environment. This is possible if the country increases its engagement in activities of production that have less adverse effects on the environment. A report by Qatar National Bank (2015) states that the share of the non-hydrocarbon sector in Qatar GDP in the second quarter of 2015 was 61.7% which came from financial services, construction, restaurants and hotels, government services, manufacturing, transport and communications, and social services; ordered by relative contribution. Despite the resulting economic diversification, many of these activities pose the same threat on the environment and so diversification at its current state is a new challenge facing the country. The manufacturing sector of Qatar is heavily made up of petrochemical companies, fertilizers, aluminium, and steel among others. Evidently, they are derivatives of fossil fuel and in fact have a negative impact on the environment as well. Construction, which is a major player in the non-oil and gas sector, is also a threat to the environment given its resulting emissions and extensive use of energy (Lawrence et al., 2012). Therefore, economic diversification in Qatar must move towards activities that are neither derivatives of the hydrocarbon sector nor activities that introduce new challenges to the environment.

² Bidirectional causality also called the feedback hypothesis means that causality runs in both directions, from energy consumption to economic growth and vice versa. In this case, it is not recommended to impose energy conservation policies because it could slow down economic growth.

³ Unidirectional causality running from energy consumption to economic growth is known in the empirical literature of the energy consumption-economic growth nexus by the growth hypothesis. In the literature two other hypothesis called energy conservation and neutrality hypothesis are also usually investigated. Conservation hypothesis is found when economic growth causes energy consumption and it means that energy conservation policies can be used to reduce CO₂ emissions because it is unlikely to have an adverse effect on economic growth. However, the neutrality hypothesis indicates that neither energy consumption causes economic growth nor economic growth causes energy consumption.

5. POTENTIAL INITIATIVES TO PRESERVE THE AIR QUALITY

Given the risks associated with air pollution and the challenges that Qatar is facing, there are some initia-

tives that could be undertaken to reduce the severity of the problem.

5.1. RATIONALIZE AND CONTROL THE USAGE OF ENERGY

Given that most of the energy comes from the burning of fossil fuel, it is important for the country to take initiatives that promote the proper use of energy at both firms and consumers level. The government should impose more regulations that require firms in industries of hydrocarbon and its derivatives to implement processes that reduce CO₂ emissions from their operations and impose fines on violators. At the consumer level, energy use must be controlled as well since individuals in Qatar are also responsible for the damage to the environment. Records show that Qatar has the highest per capita electricity and water consumption (Meier et al., 2013). According to Qatar's inter-ministerial Permanent Population Committee, water consumption of the average resident of Qatar is twice the average set by the European Union. As discussed previously, water in Qatar comes from the energy-intensive process of desalination. Therefore, the government must take serious measures to guide the consumption of energy by the people. Qatar has the world's highest per capita energy subsidies (IMF, 2015), despite increasing welfare for the people by allowing them to pay lower prices, subsidies lead to excessive use of energy (IMF, 2015). Therefore, policymakers should re-assess the subsidy measures to move towards lower subsidies and impose energy tax to influence firms and consumers behaviour to become more efficient users of energy.

5.2. RENEWABLE ENERGY

One highly recommended measure is to reduce of the reliance of electricity generation on fossil fuel and alternatively generate it from renewable energy sources which is more environmentally friendly. Solar power is the most convenient form of renewable energy that Qatar can employ. When comparing CO₂ emissions, it is shown that natural gas emits between 0.6 and 2 pounds of CO₂ equivalent per kilo-watt hour (CO₂E/kWh), whereas solar power emission ranges between 0.07 to 0.2 (CO₂E/kWh) (RESET, 2015). Thus, moving some of electricity generation from natural gas to solar power will have a huge impact on the state of the environment. As of now, renewable solar power is not being used, but there is a move towards implementing it in the coming years. Qatar aims towards achieving 20% generation of domestic electricity demand from renewable sources by 2030 (Eversheds and Earnest & Young, 2013).

However, the challenge remains in ensuing that a considerable amount of energy is actually generated from this new source.

5.3. REDUCE DEPENDENCY OF ECONOMIC GROWTH ON OIL AND GAS

Given that Qatar has the highest GDP per capita and most of the GDP comes from the oil and gas sector, implementing regulations on energy use would harm the economy. Therefore, reducing the reliance on the oil and gas sector by replacing it with other sources will help foster economic development.

5.4. INCREASE GREEN AREA IN QATAR

Scientifically, green lands play an important role in replacing the CO₂ with oxygen. According to Environment Electronic Encyclopedia, in 2012 the green space per capita in Qatar was approximately 4 square meters, compared to the 25 square meter for the world. Therefore, more efforts are needed in order to resist the increasing level of CO₂ emissions and reduce its harms.

6. CONCLUSION

Reducing air pollution remains a challenging task, especially for countries characterized by high levels of CO₂ emissions per capita such as Qatar. It is well

known that air pollution has adverse effects on health and human life in general. However, as the most important part of Qatari GHG emissions is caused by energy consumption, it is very important to examine how one can reduce the GHG emissions to better improve the air quality without harming economic growth. This is a very complex task for policymakers since recent studies show a causal relationship running from energy consumption and electricity consumption to economic growth (Charfeddine, 2016; and Charfeddine et al., 2016). Thus, the potential initiatives proposed in this white paper are mainly based on these findings. Among these proposed initiatives, it is important to rationalize and control the usage of energy. In addition, it is very important to promote renewable energy as another source of energy. Moreover, reducing the dependency of economic growth on oil & gas and increasing the green area would help in enhancing the air quality and reducing CO₂ emissions.

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