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Greenhouse gas emissions from energy sector in the United Arab Emirates – An overview

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ABSTRACT

The largest contributor of greenhouse gas (GHG) emission in the United Arab Emirates (UAE) is the energy sector. More than 90% of the total GHG is emitted from this sector. The rapid rise of population, high rate of urbanization, rapid economic growth, and low energy cost increase the demand for energy. The consistently increasing trend of energy consumption and GHG emissions pose a challenge for the country. This study has (i) investigated the major sources of energy consumption and GHG emissions, (ii) analyzed the growth pattern of the source categories, (iii) forecasted the GHG emissions under the business-as-usual and the reformed scenarios, (iv) synthesized widely varied initiatives of the UAE in GHG emission mitigation, (v) highlighted the challenges in deploying renewable energy resources, and (vi) discussed on the possible GHG mitigation approaches. The findings of this study will contribute in preparing national GHG emissions inventory, investigating the dynamics of national GHG emissions with particular reference to the energy sector, developing possible future energy outlook scenarios, and selecting appropriate policy measures to mitigate GHG emissions.

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1. Introduction

The UAE is a country comprised of seven emirates located on the Arabian Gulf. It is among the world's leading producers and

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exporters of oil and gas. The total oil supply from the country was 3.2 million barrels per day in 2012. The annual production of natural gas was 1.85 billion cubic feet in 2012 [1]. As the domestic consumption is much less than the production, the country earns significant amount of revenue by exporting oil. According to the International Monetary Fund (IMF), the hydrocarbon export revenues reached $118 billion in 2012, accounting for approximately 80% of government revenues.

In spite of the huge revenue from hydrocarbon export, the economy of UAE is considered as a diversified one in the Arabian Gulf region. Beside the implementation of projects on refinery and petrochemicals, UAE has invested largely on non-oil sectors like tourism, real estate, banking, technology, etc. As a result, Dubai became a center for tourism, international trade, and finance. In 2012, the oil and gas accounted for approximately 42% of the national GDP [2]. Moreover, the Abu Dhabi Emirate has set forth an ambitious target to earn 50% of its GDP from non-oil sector by 2015.

The increasing rate of population, rapid urbanization and low cost of energy has made UAE as one of the highest per capita energy consumers in the world [1]. The total population of UAE in 2010 was about 8.3 million people, which is approximately double of that in 2005 [3]. The annual average population increase was 19% between 2005 and 2010 (Fig. 1). The current urbanization rate of UAE is approximately 83%.

The increasing demand for energy and the associated GHG emissions has made the energy sector as the major sector of GHG emissions in the UAE. This study endeavored to investigate the dynamics of national GHG emissions emphasizing on the energy sector. In order to understand the current pattern of GHG emission, data from both national and international agencies were used. The Ministry of Energy of UAE is the key national agency and U.S. Energy Information Administration (EIA), World Bank (WB) and World Resource Institute (WRI) are the international agencies who had the necessary data for this study. Usually, the national communication reports of individual countries are the basic sources of the data for the international organizations.

This study attempted to portray the past, present, and future GHG emissions scenarios of the UAE focusing on possible mitigation opportunities and challenges. The next section analyzes the current and future GHG emissions from different sectors. The third section presents the current status of fossil fuel consumption. The fourth section investigates the growth of major source categories of energy sector in terms of GHG emissions. The fifth section illustrates the possible future GHG emissions outlook of the UAE. The sixth section discussed on plan, policy, and program pertaining to energy pricing. The next four sections investigate the challenges and opportunities of GHG emission reduction, and GHG emission mitigation initiatives of the UAE.

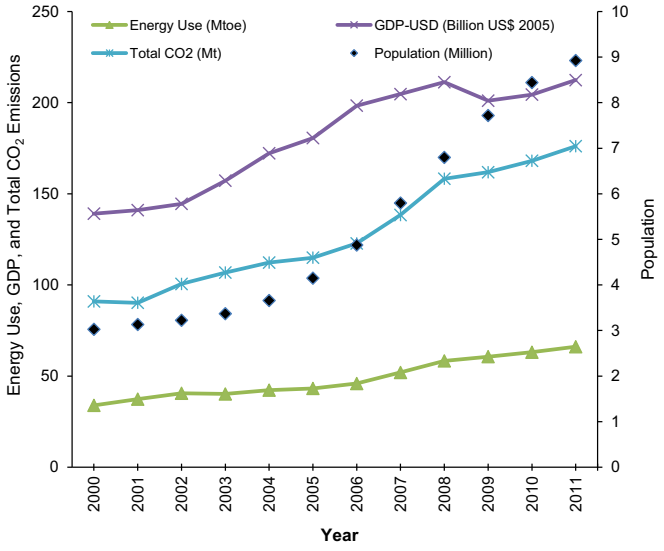

Fig. 1. Energy use, GDP, and total CO_2 emissions in the UAE
Source: [4] and [5].

2. GHG emissions in UAE

The UAE submitted three national communications containing the national inventories of direct and indirect GHG emissions for 1994 [6], 2000 [7], and 2005 [8]. According to the 1994 national communication, the total GHG emissions in the UAE was 78.653 million ton (Mt) CO_2-equivalent (CO_2-e) which increased by about 121% in 2005 [6,8]. The increase of emissions for the energy, industrial process, waste, and agriculture sectors were 117%, 174%, 179%, and 124%, respectively [6,8]. The growth of GHG sinks increased by about 213% for the same period.

According to the 2005 national communication, the total GHG emissions were 174.357 Mt CO_2-e. The energy sector was the largest contributor with 153.833 Mt CO_2-e followed by the industrial processes sector, the waste sector, and the agriculture sector with 9.426 Mt CO_2-e, 7.122 Mt CO_2-e, and 3.976 Mt CO_2-e emissions, respectively [8]. The energy sector accounted for 88% of the GHG emissions through fossil fuels combustion and the release of fugitive emissions [8]. The industrial processes sector, waste sector and agriculture sector accounted for 6%, 4% and 2% of total emissions, respectively [8]. The carbon dioxide sequestration by the land use and forestry sector in 2005 amounted to 13.223 Mt [8]. The net GHG emissions were estimated at 161.134 Mt CO_2-e in 2005.

In 2011, GHG emissions from the energy sector reached approximately, 195 Mt CO_2-e which was 92.24% of the national emissions on that year (Fig. 2) [5]. The remaining 7.76% of GHG emissions were produced by the other sectors. Over the six-year period between 2005 and 2011, GHG emission from energy sector had increased around 126.65% [5,8]. A simple linear regression model is developed for forecasting the national GHG emissions under the business-as-usual (BAU) scenario (Fig. 2). In this scenario, the total GHG emissions in 2020 will be more than two times of that in 2000 (Fig. 2). The continuous growth of national GHG emissions poses multiple environmental challenges for the nation.

In 2005, the emissions of CO_2, CH_4, and N_2O were 78.8%, 17.2%, and 3.5% of the national GHG emissions, respectively [8]. The perfluorocarbon (PFC) emitted from aluminum production was only 0.5% of the total GHG emissions [8]. The fugitive emission of

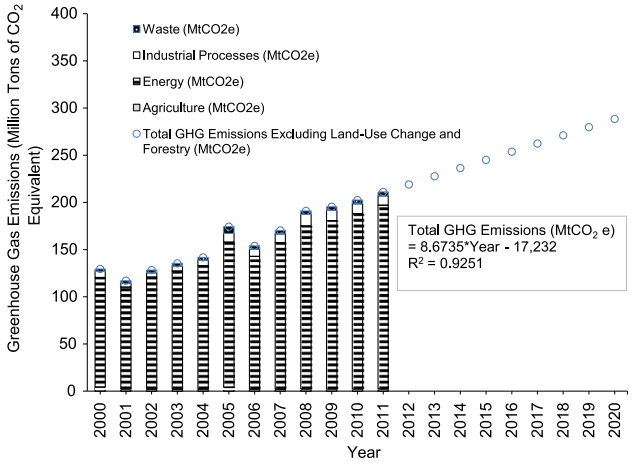

Fig. 2. National and sector-wise GHG emissions of the UAE under the BAU scenario (Source of the data up to 2011: [5], [7] and [8]).