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Energy saving and CO_2 mitigation through restructuring Jordan's transportation sector: The diesel passenger cars scenario

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Abstract

The transportation sector is responsible for 37% of the total final energy consumption in Jordan, with passenger cars taking a share of 57% in this sector. Improvement of the energy efficiency of the transportation sector can help in alleviating socio-economic pressures resulting from the inflating fuel bill and in lowering the relatively high CO_2 emission intensity. Current legislations mandate that all passenger cars operating in Jordan are to be powered with spark ignition engines using gasoline fuel. This paper examines potential benefits that can be achieved through the introduction of diesel cars to the passenger cars market in Jordan. Three scenarios are suggested for implementation and investigated with a forecasting model on the basis of local and global trends over the period 2007–2027. It is demonstrated that introducing diesel passenger cars can slow down the growth of energy consumption in the transportation sector resulting in significant savings in the national fuel bill. It is also shown that this is an effective and feasible option for cutting down CO_2 emissions.

Keywords: Energy; Transportation; Jordan

1. Introduction

From a global perspective, transportation is the single most important sector for oil demand. At 34.5 million barrels of oil equivalent per day (mboe/d), the transport sector accounted for 47% of the world oil demand in 2001 (Shihab-Eldin et al., 2004). In the countries of the Organisation for Economic Co-operation and Development (OECD), the transport sector accounts for 54% of primary oil demand while it drops to around 33% in the developing world. This difference is primarily due to the relatively larger share of the industrial sector in developing countries and the reliance on oil in electricity generation. Within the transportation sector, road transportation is the most important source of demand, accounting for over 80% of the global transportation oil demand (IEA, 2002).

In the next two decades, transport is expected to grow faster than any other sector and the growth of energy demand in non-OECD countries is expected to be three times higher than in OECD. The International Energy Agency's (IEA) World Energy Outlook base case projection, which assumes stable fuel prices and no new policy action, foresees total transport energy demand growing 40% in the OECD and nearly 140% in non-OECD countries from 1997 to 2020 (IEA, 2000). Accordingly, the transport sector's share of oil demand will grow to 62% in OECD countries and 42% of non-OECD countries by 2020.

Growth of energy demand is mainly due to increasing vehicle ownership levels combined with growth in transport activity, which in turn is tightly linked to income growth. Trends in transport activity are rising steadily and show few signs of saturation that might moderate growth in the future. World vehicle ownership has been growing steadily, reaching 800 million vehicles in 2000. Over the past three decades, the developing countries witnessed the highest rates of growth in vehicle ownership. This trend is expected

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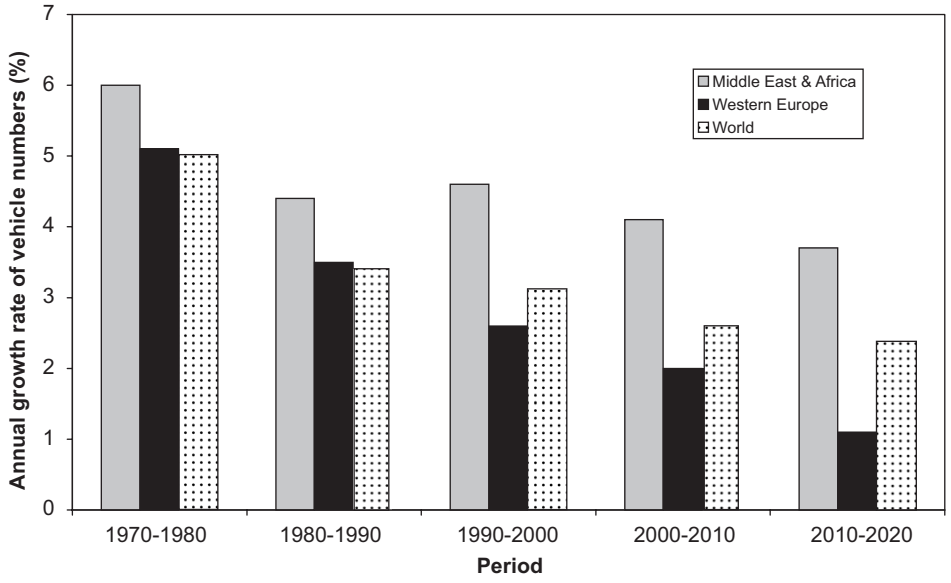

Fig. 1. Documented and projected annual growth rates for vehicle ownership for 'Western Europe' and 'the Middle East and Africa' regions against world rates.

to continue in the future due to the current low levels of vehicle ownership in developing countries which provide obvious scope for increases. Fig. 1 shows the documented and projected annual growth rates for vehicle ownership for Western Europe and the Middle East and Africa regions against world rates (Shihab-Eldin et al., 2004). It is beneficial here to note the stark difference in vehicle ownership levels between OECD and developing countries. For example, in year 2000 vehicle ownership in Western Europe was around 0.444 vehicle/person compared to only 0.033 vehicle/person in the Middle East and Africa region.

Although CO_2 emissions were not initially included in most emission legislations, this has started to change over the past few years. Currently, CO_2 is regulated in many parts of the world either directly as in the case of Japan, or indirectly as in the case of the European Union (EU) countries. This is mainly due to the belief that CO_2 is responsible for around 80% of the anthropogenic climate change and global warming effects (Ritter, 1998). Since the 1960s tropospheric CO_2 concentration has been increasing at an annual rate of 0.45% (Lenz and Cozzarini, 1999). Road transportation has been playing an important role in this steady increase. In the EU countries, it is responsible for around 21% of the total anthropogenic CO_2 emissions (Ritter, 1998). These concerns have been addressed in Rio and Kyoto summits leading to the adoption of the "Kyoto Protocol" which demanded a worldwide reduction of CO_2 emissions by at least 5% compared to the 1990 level by year 2010 (UNFCCC, 1997). The effective Kyoto Protocol does not have binding commitments for developing countries to reduce their greenhouse gas emissions. However, there is increasing pressure for developing countries to adopt some kind of target. As most developing countries are not currently in the position to make absolute emission reductions, the most immediate and realistic challenge is lowering the CO_2 intensity (How many tons of CO_2 emissions are emitted per US dollar of the Gross Domestic Product (CO_2/GDP)?) (Kuntsi-Reunanen, 2007).

2. National energy and emissions status

Jordan is a lower-middle income Middle Eastern country, of about 5.8 million inhabitants, that suffers from a chronic lack of adequate supplies of natural resources including water and oil. Jordan depends heavily on imports of oil from neighbouring countries as the main source of energy. Its current imports of around 100,000 barrels of crude oil per day are placing the country under extreme economic pressures. The annual fuel bill has been rapidly increasing over the past few years due to population and economic growth combined with the consecutive increases in oil prices.

In 2005, Jordan's consumption of primary energy[1] amounted to 7.028 million Ton Oil Equivalent (TOE). Nearly 95% of this consumption came in the form of imports of crude oil, natural gas and petroleum products. The remaining 5% came in the form of renewable energy and imported electricity. The final energy[2] consumption for the same year amounted to 4.802 million TOE, an increase of 6% on the 2003 consumption (Ministry of Energy and Mineral Resources (MEMR), 2005). Fig. 2 illustrates the growth in total primary and final energy consumption over the period 1995–2005, while Fig. 3 shows the cost of consumed energy and its proportion to the national GDP (MEMR, 2005). The relatively high growth rates of energy consumption, cost and proportion to the GDP are evident,

[1]Primary energy refers here to the energy products provided by nature in their direct form, such as petroleum, natural gas, coal, etc.

[2]Final energy designates the energy as received by the users in different sectors, such as gasoline, diesel, kerosene, etc.