

# Comparative Risk Assessment of Commuting Traffic Congestion in Dubai

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**Abstract.** The traffic congestion related to peak commuting hours can create multiple effects on public health, environmental conditions and economic stability. Because of the unique nature of Dubai in terms of urban planning, population expansion, car dependence in addition to being a tourist and economic hub in the Gulf, Dubai's suffers regular traffic congestions during peak commuting hours. In this study we applied used Comparative Risk Assessment (CRA) framework to evaluate and rank five selected major congestion related threats. The five identified threats are traffic related air pollution, commuter stress, noise pollution, productivity loss and transport greenhouse gas emission. The CRA relied on the published data by Dubai's Roads and Transport Authority (RTA), the world air index data (AQICN) and other previously published studies. Our analysis shows that air pollution exposure and commuter stress share the highest composite scores (more than 4/5). This signals urgent need for integrated mitigation straggles. The study discussed some evidence based innovative solutions such as congestion responsive low emission zones, flexible work policies and micro mobility expansion and propose phased implementation to maximize the overall benefits for health, environment and carbon footprint. The study demonstrates how CRA can guide urban mobility policy in rapidly growing cities like Dubai.

**Keywords:** comparative risk assessment, traffic congestion risks, Dubai Traffic, environment.

## 1. Introduction

Commuting congestion in Dubai is an urban multifaceted problem that bears serious environmental, health and economic consequences. With rapid urbanization along with increasing number of vehicle ownership, the city is facing progressively increasing traffic, especially during peak hours, which places pressures on city's infrastructure and urban services (Haider et al., 2013). Increased congestion leads to more emissions, causing air quality to be reduced along with the decline of wellbeing of commuters (Levy et al.,

2010). Office workers who commute daily are most affected by traffic congestion in Dubai leading to heightened travel time resulting in increased stress, anxiety, and fatigue as well as reduction of mental wellbeing and productivity (Gottholmseder et al., 2009). Congestion contributes to higher operational costs and productivity loss (St-Louis et al., 2014) and ultimately decline economic performance of the city. This study gives a systematic comparative analysis of the effects of commuting traffic congestion in Dubai, evaluates and ranks them in different domains. This study aims at identifying and ranking possible threats associated with commuting traffic congestion.

## Methods

This section provides a comparative evaluation of the major environmental, health, and socio-economic risks of commuting congestion in Dubai. In the analysis, data from three air quality monitoring stations (Zabeel Park, Deira Union Square and U.S. Embassy), operational energy records from Roads and Transport Authority (RTA) (RTA Open Data, 2022) and peer reviewed literature were consulted. A five-criteria scoring system adapted from WHO and U.S. EPA frameworks is used to assess each risk in terms of severity, exposure, duration, reversibility, and public concern. Each risk is scored from 1 (low) to 5 (high) across these dimensions, with the average score used to rank and prioritize risks.

## 2. Results:

### Traffic-Related Air Pollution Exposure

Category: Health

Score: 4.1 / 5

All risks together make a composite risk which consists of PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub> and CO where PM<sub>2.5</sub> is used as lead indicator owing to its extensive association with respiratory and cardiovascular diseases, higher exceedance, and higher relevance to traffic emissions relative to the other pollutants (Turner et al., 2011; Münzel et al., 2018).

### Noise Pollution from Traffic

Category: Health/Environmental

Score: 3.8 / 5

Traffic related noise pollution is an emerging but insufficiently addressed environmental health risk in Dubai. In urban areas with high population densities,

chronic exposure to road traffic noise raises peoples' risk of stress, disturbed sleep, impaired cognitive function and cardiovascular disease (Münzel et al., 2018; Sørensen et al., 2021).

### **Economic Productivity Loss Due to traffic**

Category: Economic/Social

Score: 3.8 / 5

Traffic congestions lead to huge time and efficiency losses. The Roads and Transport Authority (RTA) confirms that Dubai has an economy loss of AED 2.9 billion annually because of delays, operational disruptions, and higher transport costs, with costs exceeding AED 771,000 per kilometer in 2013 (Gulf News, 2014). Yet, this loss is partially reversible, if smart infrastructure and policy are used.

### **Greenhouse Gas (GHG) Emissions**

Category: Environmental

Score: 3.4 / 5

According to recent studies on Dubai's transport emissions, road transport remains a significant contributor to UAE's carbon footprint, accounting for approximately 20% of total emissions (Al-Mulali et al., 2020). Air pollution is evaluated separately from this risk because it has long term wide environmental implications.

### **3. Summary and recommendations:**

Given the key environmental, health, and socio-economic risks identified by the comparative risk assessment, the following evidence-based policies are recommended: Implementation of Congestion-Responsive Low Emission Zones (LEZs) should be implemented in high traffic areas. Moreover, flexible work arrangements such as hybrid models, staggered hours and compressed workweeks will also decrease traffic and decrease emissions and commuter stress. As Tokyo's staggered shifts successfully reduced vehicle flow by 10% and delays by 80% during the 2020 Olympics (ITF Deployment Evaluation, 2023), similar approaches could benefit Dubai.

Public transport and micro mobility (BRT systems, e-bikes, shaded walkway...etc) investments are also part of reducing emissions. For instance, Bogotá's BRT was attributed to avoiding emission of 350,000 metric tons of CO<sub>2</sub> annually (ICLEI, 2018; Rockefeller Foundation, 2015) and Singapore's public transport systems contributed to significant PM<sub>2.5</sub> reductions (World Bank Transport Data, 2022). For reducing sound related environmental stressors, the establishment of urban noise monitoring and management systems is inevitable. Real-time acoustic sensors can be deployed to monitor continuously pollution hotspots.

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