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An evaluation of the impact of the Dublin Port Tunnel and HGV management strategy on air pollution emissions

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ABSTRACT

Heavy Goods Vehicles (HGVs) contribute a large proportion (about 40%) of the emissions of air pollutants while only representing a small proportion (about 10%) of all transport operations. In Ireland, the Dublin Port Tunnel (DPT) was opened in 2006 as a dedicated route for HGVs between Dublin Port and the motorway system in order to reduce the HGV volume in the city centre. An HGV management strategy to restrict HGVs travelling through the city centre was also introduced. The aim of this study was to estimate the emission changes brought about by these infrastructural and regulatory changes. A transport model built in VISUM was utilized. Emissions were calculated using COPERT 4. The results showed that the DPT and HGV management strategy reduced the traffic in the city centre, and the HGV management improved traffic speed distribution. However the DPT and HGV management resulted in vehicles travelling further (travel distance increased by 16% and 51%, respectively) and increased the total emissions (increased by 8% and 21% in NO_x, respectively). Total traffic and emission changes over time in Dublin were also estimated in this study. The traffic conditions and emissions in 2006, 2007 and 2013 were evaluated and the results indicated that a travel demand reduction in 2013 could also improve speed distribution. Emissions reduced from 2006 to 2013 and the fleet technology improvements had a positive impact on this reduction. The study shows that a traffic management policy and/or infrastructure change may bring about some localised environmental benefits within the management area; however, such a policy does not always reduce the total traffic emissions in the network as a whole and the impact to the wider environment could be negative in some circumstances.

1. Introduction

Traffic is one of the major users of energy and one of the major polluting sectors. It is considered a significant cause of the monitored exceedances of ambient air quality limit values in urban areas (EEA, 2013a). In 2011, the contribution of road transport emissions to nitrogen oxide (NO_x) and carbon monoxide (CO) in Europe amounted to 40% and 26%, respectively (EEA, 2013b). Traffic is also a major source of particle emissions (PM_{10} and $PM_{2.5}$) (Pant and Harrison, 2013).

Compared to industrial and other air pollution causes, air pollution from road transport is more likely to affect people, because the source of air pollution from transport, i.e. vehicles are often within close proximity to residential and workplace locations, in addition to exposure during commuting. Among all traffic modes, Heavy Goods Vehicles (HGVs) are a significant

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contributor to traffic pollution. An OECD report highlights that trucks can produce over 40 percent of the pollution where they only account for 10 percent of all transport operations in urban areas (OECD, 2003).

Governments all over the world are taking actions to reduce traffic emissions and to build a sustainable urban transport system. Some commonly considered options in cities for these purposes include: road infrastructure, public transport, technological solutions, vehicle access restrictions and control of land-uses (Pojani and Stead, 2015).

In cities, regulations aimed at restricting vehicle access have had an important impact on traffic emissions and air quality. In London, a low emission zone (LEZ) was implemented in 2008, which restricted some vehicles entering the zone. Ellison et al. (2013) concluded that the LEZ may have reduced PM_{10} emissions by 2.47–3.07% within the zone whereas by only 1% outside the zone. In Munich, after the implementation of a LEZ, PM_{10} concentrations in the LEZ were found to be reduced by 5–12% at almost all the monitoring sites (Cyrys et al., 2009). In China, some cities have implemented a license plate restriction policy, which prohibit a portion of cars entering the restriction zone at a particular time. Pu et al. (2015) found that in the license plate restriction zone in Hangzhou city in China, emissions decreased by 6.9%.

Transport infrastructure changes influence emissions and air quality as well as influencing traffic flows. Lozano et al. (2014) found a new toll highway had positive effects on emissions in the short term in Mexico City. Bandeira et al. (2013) estimated the emissions impact of vehicles choosing different routes. They found that faster intercity routes tended to reduce fuel use and CO_2 emissions, however they increased emissions of carbon monoxide, nitrous oxides, and hydrocarbons by up to 150% (Bandeira et al., 2013).

Focusing on Ireland, the national government proposed a set of strategies to reduce transport air pollution and CO_2 emission, including: regulating vehicle standards, implementing compulsory measures to restrict large vehicles, encouraging people to shift transport mode, and launching large infrastructural projects (Department of the Environment Heritage and Local Government, 2007).

In Dublin city, strategies taken that have had impacts on traffic emissions include improved infrastructure and vehicle restriction access: the Dublin port tunnel (DPT) was opened on December 20th 2006 as a dedicated route for HGVs between Dublin Port and the national road network to remove trucks from the city centre. A HGV management strategy was introduced on the 19th of February 2007 in Dublin. This strategy implemented a ban on 5+ axle HGVs prohibiting them from entering the city cordon area (roads that within the cordon area are shown in Fig. 1 in red). It aimed to encourage maximum use of the Port Tunnel by port related traffic and thus to minimize the numbers of trucks on the city streets. This would in turn enhance the city centre environment through reduced congestion, noise and air pollution (O'Brien and Bolger, 2009).

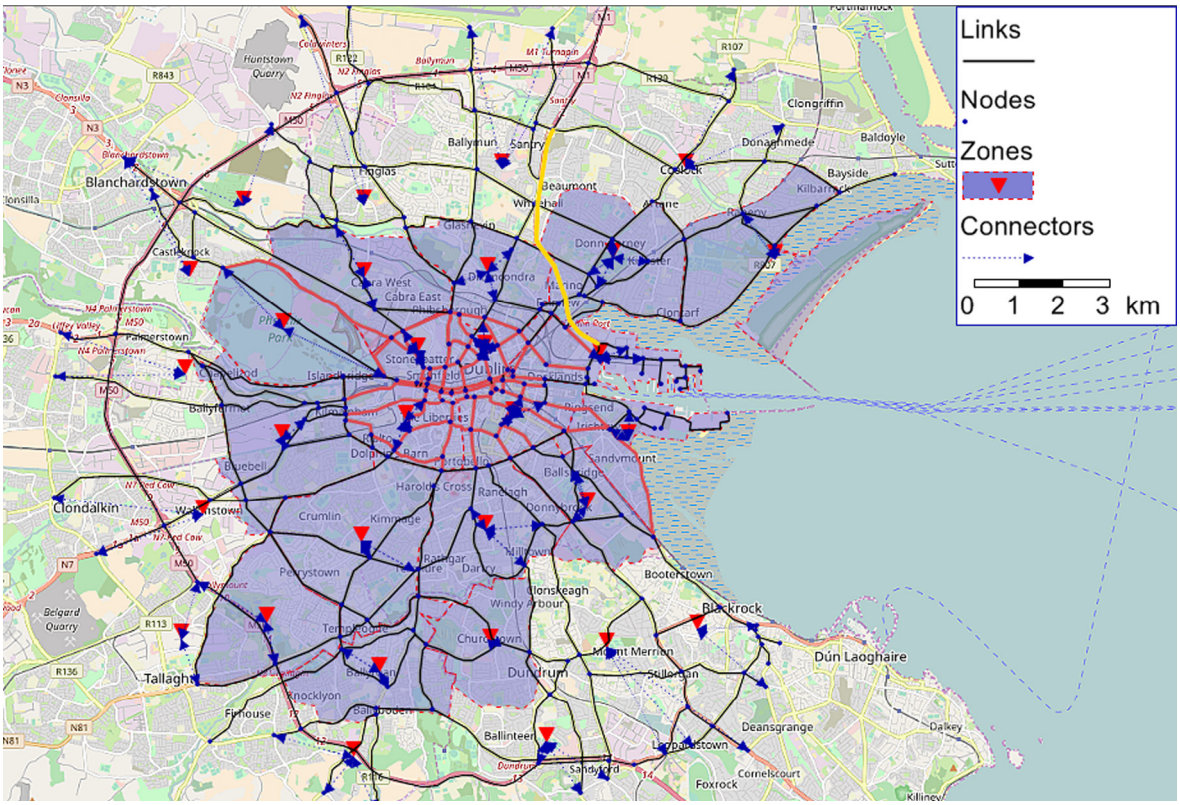

Fig. 1. The VISUM network and prohibited links for HGVs within cordon area (red links). The Yellow link represents the location of the DPT. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)