

Secure Challenge

Air Pollution and Health

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HPS



Pollution

Air pollution kills more people in the UK than in Sweden, US and Mexico

WHO figures show people in Britain are more likely to die from dirty air than those living in some other comparable countries



2,932 845

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A face mask placed on the statue of Queen Victoria opposite Buckingham Palace to highlight air pollution. Photograph: Dan Kitwood/Getty Images

People in the UK are 64 times as likely to die of air pollution as those in Sweden and twice as likely as those in the US, figures from the World Health Organisation reveal.

Britain, which has a mortality rate for air pollution of 25.7 for every 100,000 people, was also beaten by Brazil and Mexico - and it trailed far behind Sweden, the cleanest nation in the EU, with a rate of 0.4.

Air Pollution and Health Impacts

- **Short term exposure to particulates (PM)**
 - asthma attacks, GP visits, hospital admissions and earlier deaths
- **Short term exposure to ozone**
 - aggravates respiratory conditions, earlier deaths from cardio-respiratory conditions
- **Long term PM exposure**
 - increase mortality from heart attacks, stroke, lung cancer and chronic (non-cancer) lung disease (PM_{2.5})

Air Pollution and Health Impacts

- **Long term PM exposure**
 - increased hospital admissions for respiratory causes in Glasgow and Edinburgh (PM₁₀ and NO₂) (Lee et al 2009)
 - association with emergency cardiac admissions in Edinburgh (PM₁₀, 3 day mean, Prescott et al 1998)
- **Long term NO₂ exposure**
 - increased mortality risk in adults etc.
 - strong association with particulate pollution effects but effects at least in part caused by NO₂ itself

Challenge Question:

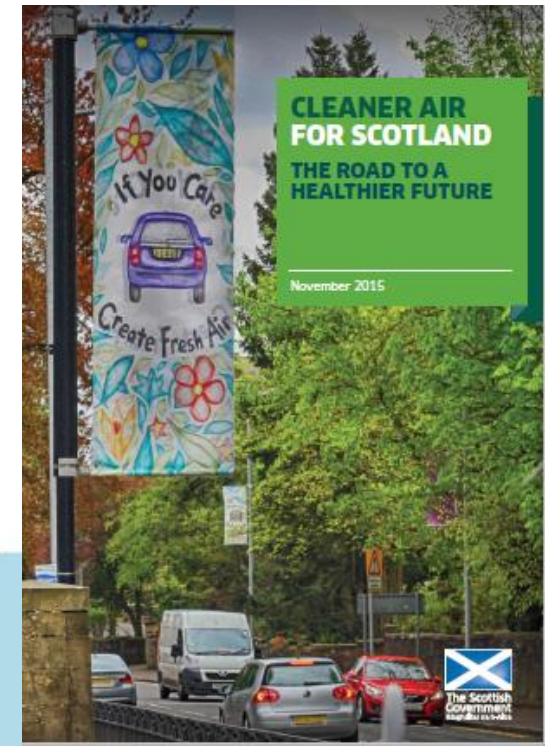
To what extent do areas at a small area level (lower than whole local authority locality or NHS board boundary level) with elevated levels of air pollution (particulates, NO₂ and ozone) coincide with areas having elevated levels of mortality and / or morbidity associated with air pollution related health impacts; specifically respiratory disease (asthma and chronic obstructive pulmonary disease (COPD)) cardiovascular disease and lung cancer.

Background

Cleaner Air for Scotland Strategy (CAFS)

Section II – National Low Emissions Framework (NLEF)

- Low Emission Zones (LEZ) well established across Europe (first 1996 – Sweden)
- Benefits and challenges of implementing an LEZ vary
- No LEZs in Scotland to date – some feasibility studies only
- S. Gov. commitment to introduce first LEZ by 2018



Background on LEZ

Aims of LEZ

- Ultimate aim is to reduce adverse health impacts due to air pollution by reducing toxic traffic emissions
- Reduce number of higher emission vehicles (cars, taxis, buses, lorries) in a defined area by restricting access
- Mainly used to reduce particulate (PM) emissions
- Some targeted at reducing NO₂

Background on LEZ

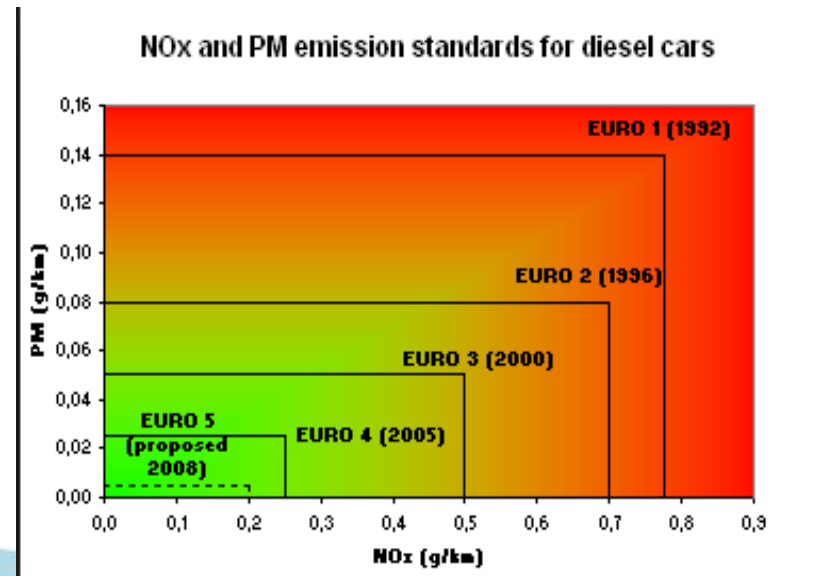
Defining Low Emission Zones

- Conventionally based on a geographic area where air pollutant levels exceed statutory limit values e.g. NO₂ annual mean 40µg/m³ ; PM₁₀ 24 hr air quality objective 50µg/m³



Aims of an LEZ

- Focus now more on diesel vehicles due to \uparrow PM + \uparrow NO_x emissions
- Use “Euro” standards for vehicles as access criteria e.g. cars; Euro 5 from 2009; Euro 6 from 2014
- Vehicles not meeting relevant Euro standard either banned or subject to an access charge
- NB distinct from a “congestion charge”



Effect of LEZ on Air Pollution

- Evidence across 200 LEZs in Europe is inconsistent - 2016 “AIRUSE” Report
- Few published studies of impact on air quality using ambient air pollution measurements
- Difficult to detect impacts attributable to LEZ
- PM₁₀
 - some reported reductions - up to 12% in Munich
 - in most LEZs - no effect on annual mean concentrations



Effect of LEZ on Air Pollution Levels

- $PM_{2.5}$ reduced in Munich and London but not Amsterdam
- Bigger impacts on carbon particles - black carbon, elemental carbon, absorption
- NO_x – reduction in London 3% to 7%
- NO_2 – 4% to 10% reduction in Berlin and other German cities
 - no impact in London or 11 Dutch cities

Effect of LEZ on Health Impacts

- 2008 – World’s largest LEZ established; most of Greater London;
- focus on diesel vehicles (HGVs, buses, coaches NOT cars)
- London LEZ Baseline Study (HEI 2011)
 - No positive associations found between exposure to NO_x and health outcomes studied (respiratory and cardiac disease)
 - some significant negative (protective) associations with exposure to pollutants.



Effect of LEZ on Health Impacts

- London Low Emission Zone and Prevalence of Respiratory/Allergic Symptoms in school children: first 3 years of LEZ operation (Wood et al 2015):
 - NO₂, PM₁₀ and PM_{2.5} all associated with “*current rhinitis*” but not with other respiratory/allergic symptoms
 - LEZ did not affect the prevalence of respiratory/allergic symptoms over study period
 - LEZ did not significantly reduce ambient air pollution levels

Low Emission Zone - Issues

- Favoured by anti-traffic pollution lobbyists, some (transport) academics and politicians
- Scope to vary vehicle types subject to restrictions
 - depends on local traffic mix and which vehicles contribute most to specific pollutants locally
- Vehicle restriction in LEZ can result in displacement of more polluting vehicles to non-LEZ areas (e.g. export of London taxis to Scotland)
- Displaced vehicles may be transferred out of city centres to residential areas, potentially increasing exposure of vulnerable groups (children, elderly, health impaired)
- LEZs costly to set up and operate; drain resources from alternatives (active travel, subsidised public transport)

Low Emission Zone - Issues

- Areas with highest traffic sourced pollution are not always residential areas (e.g. Glasgow Hope Street)
- Exposure to highest levels of pollution may be time limited
 - commuters v residents
- Potential for health gain depends mainly on exposure levels and duration (dose), esp. in more vulnerable people



Low Emission Zone - Issues

- LEZ normally designed to reduce traffic emissions in areas not meeting air quality standards
 - mainly a pollution level focus - not dose related
- Is there an alternative way to locate a LEZ to increase the (dose related) potential health gain?
- Could LEZ be focussed on locations with:
 - elevated traffic pollution levels **AND**
 - populations at highest risk of adverse health impacts?

Traffic Air Pollution and Health Challenge

Is it possible to identify areas with:

- Elevated air pollutant concentrations (PM, NO₂)

Plus

- Increased proportions of vulnerable people
 - poor cardiovascular/respiratory health
 - more deprivation
 - elevated smoking rates/smoking related morbidity

Health Data Sets

- Mortality for all causes and selected causes – cardiac, respiratory deaths
- Hospital admissions data for all causes and selected causes
- GP prescribing data for selected health outcomes (e.g. asthma, COPD, cardiac disease)
- NHS24 data

Air Pollution Data

- Scottish Air Quality Website
 - Annual pollutant maps
 - Estimated pollution levels (1KM x 1KM grid) for PM₁₀, NO_x, NO₂
 - Roadside pollutants on urban roads
- Monitoring data
- ? Restrict to 4 main cities: Aberdeen, Dundee, Edinburgh, Glasgow

Confounding Factors

- Health impacts of air pollutants increased in association with demographic characteristics and co-morbidity:
 - age, gender
 - smoking, alcohol, diet
 - pre-existing morbidity (e.g. cardiac, respiratory and other chronic conditions; e.g. diabetes)
 - deprivation
 - occupation (outdoors, road related)
- Indoor/outdoor air pollution ratios
- Time spent at residential location as a proxy for lifetime exposure to outdoor air pollution

Conclusions

- Pressure to adopt LEZs in the 4 main cities in Scotland despite mixed evidence for effectiveness in reducing air pollutant levels or delivering improved health outcomes
- Targeting LEZs by engine emission profiles/ traffic mix may not achieve any measureable health gain
- Targeting LEZs in areas with increased pollution and higher rates of poor health might increase the potential for health gain
- **Are areas with higher pollution levels correlated well enough with areas of existing poor health to develop an alternative model for defining a LEZ location?**