CONNECTING CULTURES
ENABLING ECONOMIES
6th to 10th October 2019

BEST PRACTICE GUIDE TO AIR QUALITY IN RELATION TO ROAD OPERATIONS

ENVIRONMENTAL CONSIDERATIONS IN ROAD OPERATIONS

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NEW ZEALAND TRANSPORT AGENCY

WHAT'S NEW OR DIFFERENT ABOUT THIS GUIDE?

A COMPREHENSIVE COMPENDIUM OF THEORY AND PRACTICAL GUIDANCE

This is the first comprehensive guidance that PIARC has produced on all aspects of construction and operation of roads and air quality.

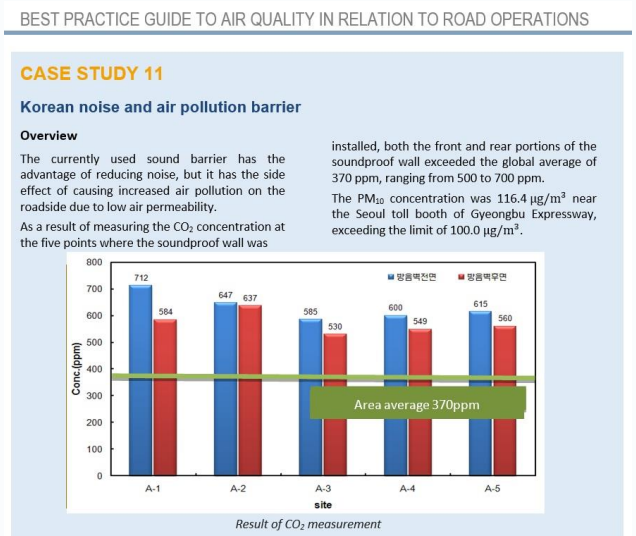
It provides a huge amount of practical guidance based on the technical committee's significant knowledge and numerous years of experience.

WHAT'S NEW OR DIFFERENT ABOUT THIS GUIDE?

A COMPREHENSIVE COMPENDIUM OF THEORY AND PRACTICAL GUIDANCE

It includes:

- 22 case studies capturing practical experience from road agencies throughout the world.
- A practitioners view of the advantages and disadvantages of different technologies for monitoring air quality near roads.
- A critical review of current evidence to understand what road agency mitigation solutions most effectively improve air quality.



WHAT TOPICS DOES THE GUIDE COVER?

KEY ELEMENTS OF BEST PRACTICE

1. Understand the impact of poor air quality caused by vehicle emissions.
2. Understand and acknowledge the role of the Road Agency and others.
3. Assess how vehicle emissions affect air quality near roads.
4. Explore options and take effective action to improve air quality.

WHAT ARE THE KEY RECOMMENDATIONS IN THE GUIDE?

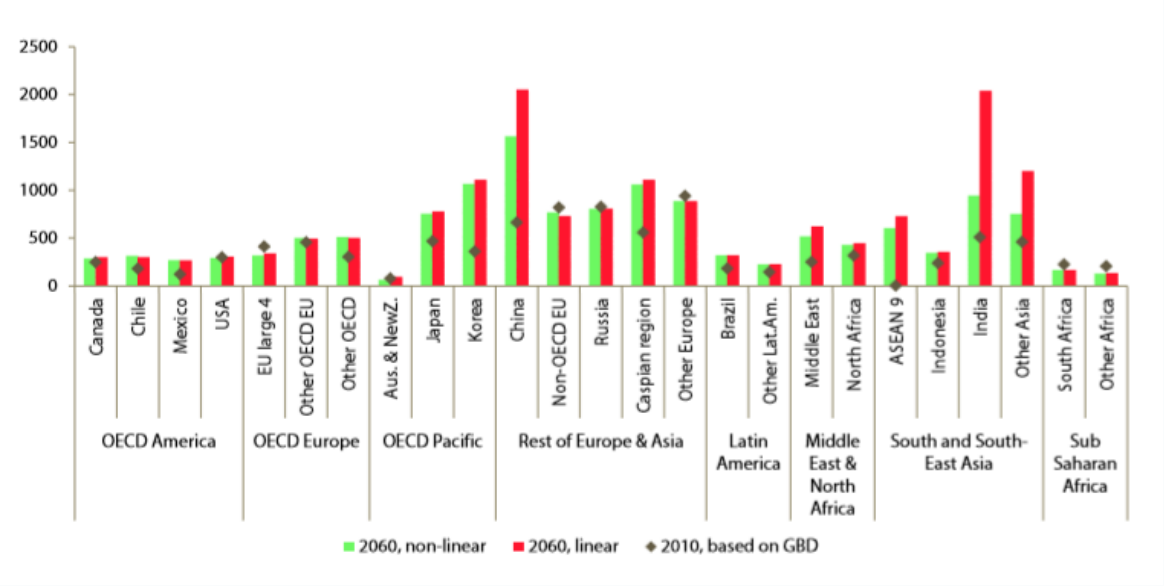
INVESTIGATE WHETHER OR NOT YOU HAVE A PROBLEM AND FIND SOLUTIONS THAT REFLECT YOUR CONTEXT

1. How significant a problem is air pollution from roads in your country or region?

2. What solutions are available to your Road Agency and your partners to address any problem(s) you identify?

WHY IS GOOD AIR QUALITY IMPORTANT?

POOR AIR QUALITY ARISING FROM VEHICLE EMISSIONS IS LINKED TO THE PREMATURE DEATH OF PEOPLE



Premature deaths from exposure to particulate matter and O_3. Projected number of deaths caused by outdoor air pollution per year per million people. Source: OECD

The OECD estimates the number of premature deaths due to outdoor air pollution, of which transport emissions represent approximately 50%, has increased from approximately 3 million people in 2010, in line with the latest Global Burden of Disease estimates, to 6–9 million annually in 2060.

WHO HAS THE GREATEST ABILITY TO ENSURE GOOD AIR QUALITY NEAR ROADS?

INTEGRATED AND COLLABORATIVE ACTION IS ESSENTIAL

HOW CAN ROAD AGENCIES INFLUENCE AIR QUALITY?

IT IS IMPORTANT TO CONSIDER THE SCOPE AND FUNCTION OF THE ROAD AGENCY

Type	Road agency type	Create policy	Offer funding or grants	Fund road building and operations	Operate roads
1	National government or agency	Yes	Yes	Yes	Yes
2	Local/regional/state authority	Sometimes	Sometimes	Yes	Yes
3	Motorway concessionary or operating company	No	No	Sometimes	Yes

Type 1: Road agencies may have a wide range of powers around transport operations and asset management and will typically be associated with national governments. Type 2: Road agencies may have more limited powers around road operations and asset management but may not be able to provide funding incentives to road users. Type 2: Road agencies may also operate a variety of road designs or structures which reflect the reference to *sometimes* in relation to policy and funding. Type 3: Road agencies may be limited to operating road infrastructure but could fund a road operation under a design, build and finance and operate contract.

Table 7: Capabilities of road agencies in relation to their ability to manage air pollution

WHAT ARE THE BEST WAYS TO UNDERSTAND IF VEHICLE EMISSIONS MIGHT BE CAUSING AN AIR QUALITY PROBLEM?

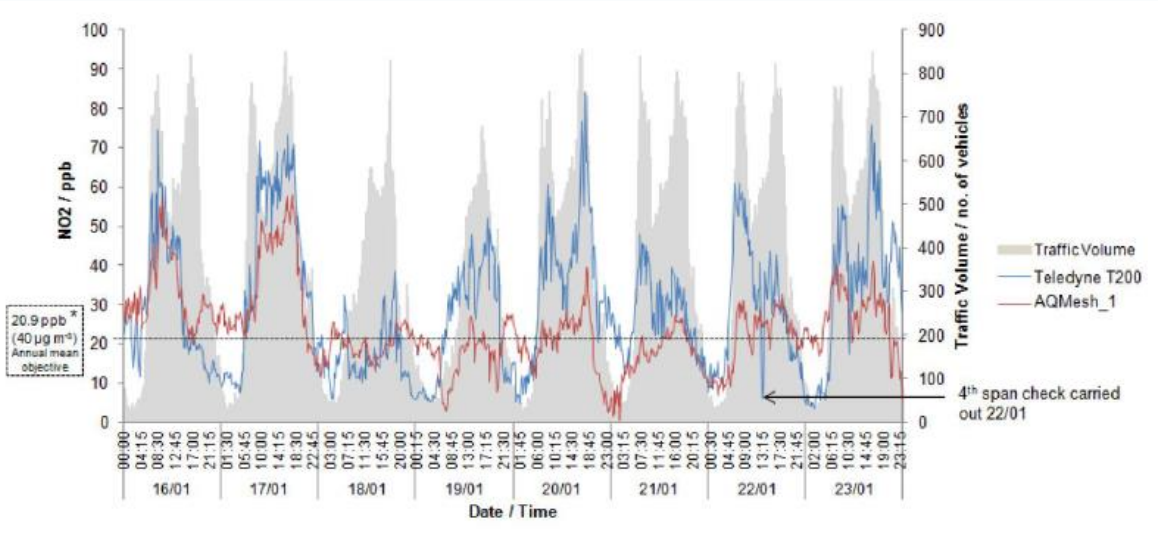
GENERATE THE 'RIGHT' DATA USING MONITORING AND MODELLING

- Understand what data is needed to inform decision making
- Design a monitoring/modelling programme and use equipment/model that will provide the desired data
- Consider metrics, data quality, complexity and cost to generate, etc

Pollutant	Equipment	Advantages	Disadvantages
NO_2	Chemiluminescence analyser	1. Capital cost. 2. USEPA reference and equivalent method for designated instruments.	1. Site visit frequency (typi 2. Mains power. 3. Air conditioned shelter
	Differential optical absorption spectroscopy (DOAS)	1. Open path instrument. 2. Site visit frequency (typically six months). 3. USEPA reference method for designated instruments. 4. Direct measurement (no converter required). 5. Air conditioned shelter not required.	1. Capital cost. 2. Mains power. 3. Reliability of data is dep protocols.
	Cavity ring down spectroscopy (CDRS)/off-axis integrated cavity output spectroscopy (OA-ICOS)/cavity attenuated phase shift spectroscopy (CAPS)	1. Site visit frequency (typically six months). 2. USEPA equivalent method for limited number of instruments. 3. Direct measurement (no converter required). 4. Lower detectable limit.	1. Capital cost. 2. Mains power. 3. Air conditioned shelter required.
	Electrochemical analyser	1. Capital cost. 2. Air conditioned shelter typically not utilised (refer to disadvantages). 3. Battery powered.	1. Site visit frequency (typically one month). 2. Lower detectable limit. 3. Effect of temperature and relative humidity on sensor gain and sensitivity. 4. Cross sensitivities with other pollutants.

HOW MUCH EFFORT IS NEEDED TO MEASURE AIR QUALITY?

LOW COST AIR QUALITY MONITORING SENSORS CAN PROVIDE USEFUL TREND DATA



NO_2 levels measured by an AQMesh low-cost sensor against Teledyne T200 reference equipment

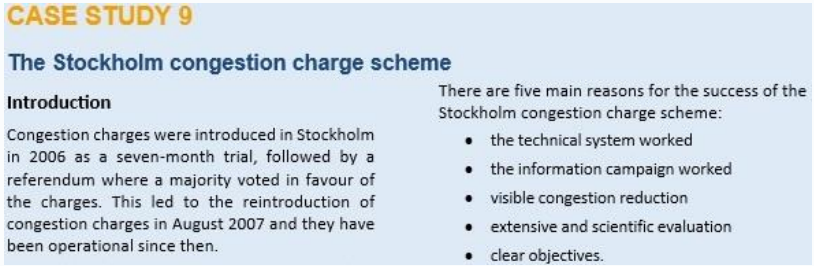
WHAT MAKES COMMUNICATION AND PUBLIC ENGAGEMENT ABOUT AIR QUALITY EASIER?

USE SIMPLE LANGUAGE AND EASY TO UNDERSTAND IMAGES

WHAT ACTION CAN ROAD AGENCIES TAKE TO IMPROVE AIR QUALITY?

THIS DEPENDS UPON THE SCOPE AND FUNCTIONS OF THE ROAD AGENCY

- **Tier 1** – A high degree of control or power to implement action, e.g. urban access restrictions.
- **Tier 2** – A moderate degree of control or power to implement action, e.g. active travel (walking and cycling).
- **Tier 3** – Limited control or power to implement action, e.g. parking restrictions.
- **Tier 4 –** No control or power to implement action but must rely on other agents to implement actions/change, e.g. in-use vehicle emission controls.



CASE STUDY 9

The Stockholm congestion charge scheme

Introduction

Congestion charges were introduced in Stockholm in 2006 as a seven-month trial, followed by a referendum where a majority voted in favour of the charges. This led to the reintroduction of congestion charges in August 2007 and they have been operational since then.

There are five main reasons for the success of the Stockholm congestion charge scheme:

- the technical system worked
- the information campaign worked
- visible congestion reduction
- extensive and scientific evaluation
- clear objectives.

WILL INTELLIGENT TRANSPORT SYSTEMS HELP ROAD AGENCIES IMPROVE AIR QUALITY?

MORE RESEARCH, TRIALS AND INNOVATION IS NEEDED

‘….technology could play an important role in reducing emissions by taking control of the acceleration of the block of vehicles, avoiding aggressive acceleration and smoothing flows…….By building in intelligence regarding the meteorological condition, acceptable levels of air quality can be maintained spatially and temporally’.

CASE STUDY 22

Emission-based speed limits on motorw
Austria

A traffic control system (VBA – Verkehrsbeeinflussungsanlage) is a telematically controlled display that flexibly signals event-based information to traffic participants. Based on traffic and environmental data, road conditions and the weather, corresponding bans, instructions or warnings are displayed as an alternative to standard traffic signs.

WHAT INTERVENTIONS TO IMPROVE AIR QUALITY NEAR ROADS HAVE WORKED AND WHAT HAVEN'T?

REVIEW THE LATEST EVIDENCE BASE

CASE STUDY 15

Roadside air – pollution vegetation barriers in Czech Republic

Background

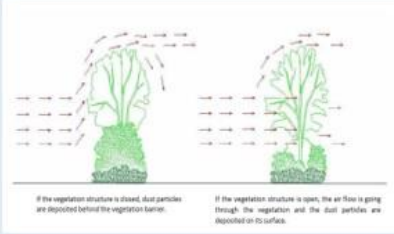
Roadside vegetation belts have been examined in Czech Republic to determine if they can protect receptors from road-based PM_{10} and $PM_{2.5}$ pollution and, to a certain extent, to the pollutants bound to the particles, i.e. benzo(a)pyrene and heavy metals.

Vegetation belts work in two ways. First, they capture pollutants on leaves, where the efficiency of this action depends mainly on the size of the leaves, the quality of their surface and the movability of the leaf blades. Second, they reduce air flow rates which reduces the kinetic speed of particles, which in turn promotes faster sedimentation.

ATEM [116] identified the main factors influencing

The method of planting vegetation in close proximity, while allowing for final growth size, delivers improved growth and engagement and a degree of self-regulation.

Method efficiency

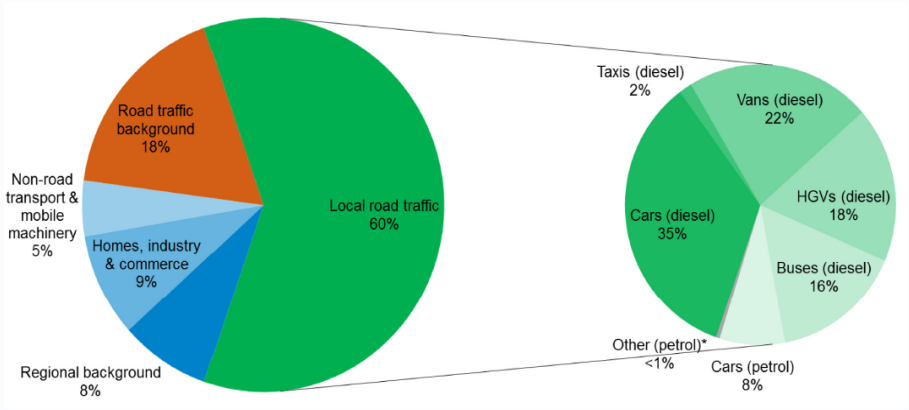


'…emissions from vehicles in Berlin were reacting with emissions from urban trees and other plants to result in a decrease in air quality in cities…'.

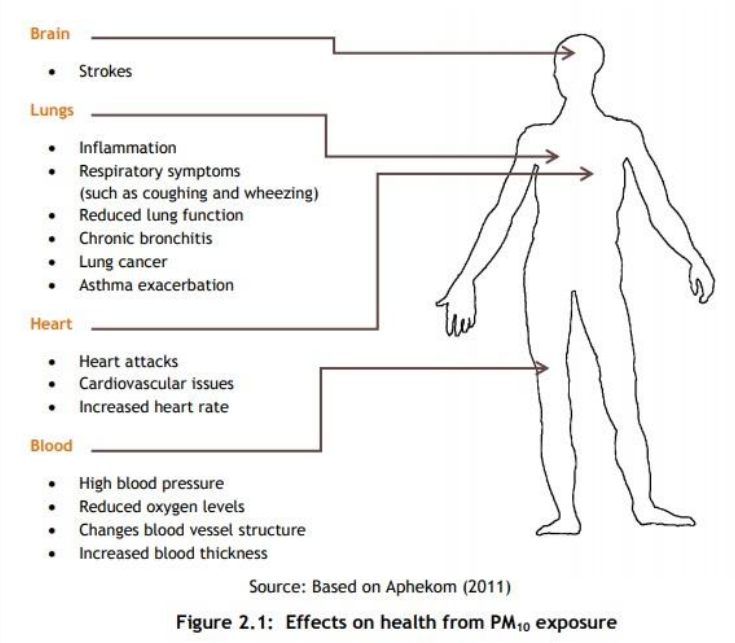
'…there is little current evidence to suggest the widespread use of photocatalytic surfaces will reduce ambient concentrations of NO_2'.

IN SUMMARY - KEY MESSAGE ONE

UNDERSTAND AND ACKNOWLEDGE THE PROBLEM



Road transport contribution to 2015 UK national average NO_x roadside concentration



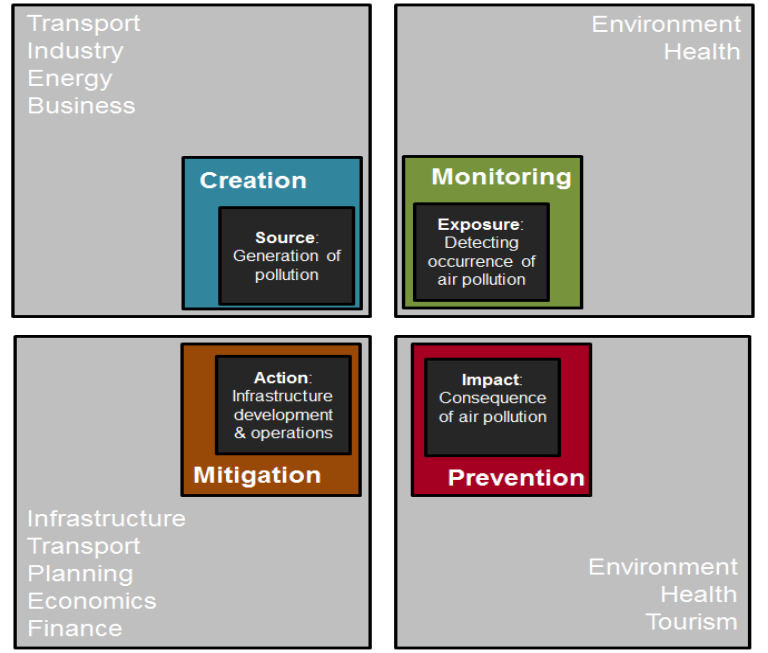
Source: Based on Aphekom (2011)

Figure 2.1: Effects on health from PM_{10} exposure

IN SUMMARY - KEY MESSAGE TWO

FIND SOLUTIONS THAT REFLECT THE NATURE OF THE PROBLEM AND THE SCALE OF THE OPPORTUNITY TO IMPROVE

'……there is no single solution to air quality issues associated with road transport…….a combination of measures will be required to achieve meaningful improvements…….'.



WHAT DOES SUCCESS LOOK LIKE?

THE IMPORTANCE OF LEARNING AND SHARING KNOWLEDGE

INSIDE SCIENCE — Reliable news for an expanding universe

CREATURE CULTURE EARTH HUMAN PHYSICS SPACE SPORTS TECHNOLOGY

Driving Fee Rolls Back Asthma Attacks in Stockholm

Study estimates that without new "congestion pricing" policy, kids would have suffered 45 percent more asthma attacks.

Stockholm, Sweden

Image credits: *S-F via Shutterstock*

‘Most people weren't worried about air pollution in Stockholm, Sweden in 2006, according to Emilia Simeonova, an economist at Johns Hopkins University in Baltimore. The city already had relatively low levels of nitrogen dioxide and fine particulates, pollutants from car exhaust that can damage lungs and exacerbate asthma. But when Stockholm started charging a fee for driving in the city center during rush hours, it reaped benefits far beyond uncrowded streets and speedy commutes. Many children who otherwise might have suffered asthma attacks were instead able to breathe easy’.

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