NSW GOVERNMENT

Tunnel Ventilation and Filtration

Fact sheet

Summer 2018

NSW Government recognises that air quality and human health is a key priority when designing road tunnels.

Strict requirements

Strict NSW air quality requirements ensure that air pollution levels are appropriately managed inside and outside the tunnel. These requirements are amongst the most stringent in the world.

Vehicle emissions

Vehicle emissions continue to reduce, despite there being more cars on the road. This is a result of advances in vehicle technology and design, as well as government initiatives to reduce emissions at the source through improved maintenance of heavy vehicles fleets.

Tunnel design and monitoring

While motor vehicle emissions are a source of air pollution, modern tunnel ventilation design ensures sufficient air flows within the tunnel to meet air quality requirements and uses elevated outlets to disperse tunnel emissions high into the atmosphere where they disperse and so become indistinguishable from background levels. The planning approval requires comprehensive monitoring to demonstrate this.

Modern tunnel ventilation

Modern tunnels are designed to achieve:

- in-tunnel air quality
- no emissions from portals
- emissions from ventilation outlets indistinguishable from background air quality.

In-tunnel air quality

The Government has set strict in-tunnel air quality requirements. These are addressed by ensuring sufficient air flow through the tunnel to prevent the build up of vehicle emissions. This air flow is achieved through a combination of :

- *traffic flow*: the turbulence created by traffic flow naturally draws air into the tunnel
- *tunnel size*: larger diameter tunnels enable more air to be drawn in by both traffic and fans
- *ventilation design*: jet fans are used to draw in additional air when the traffic slows down.

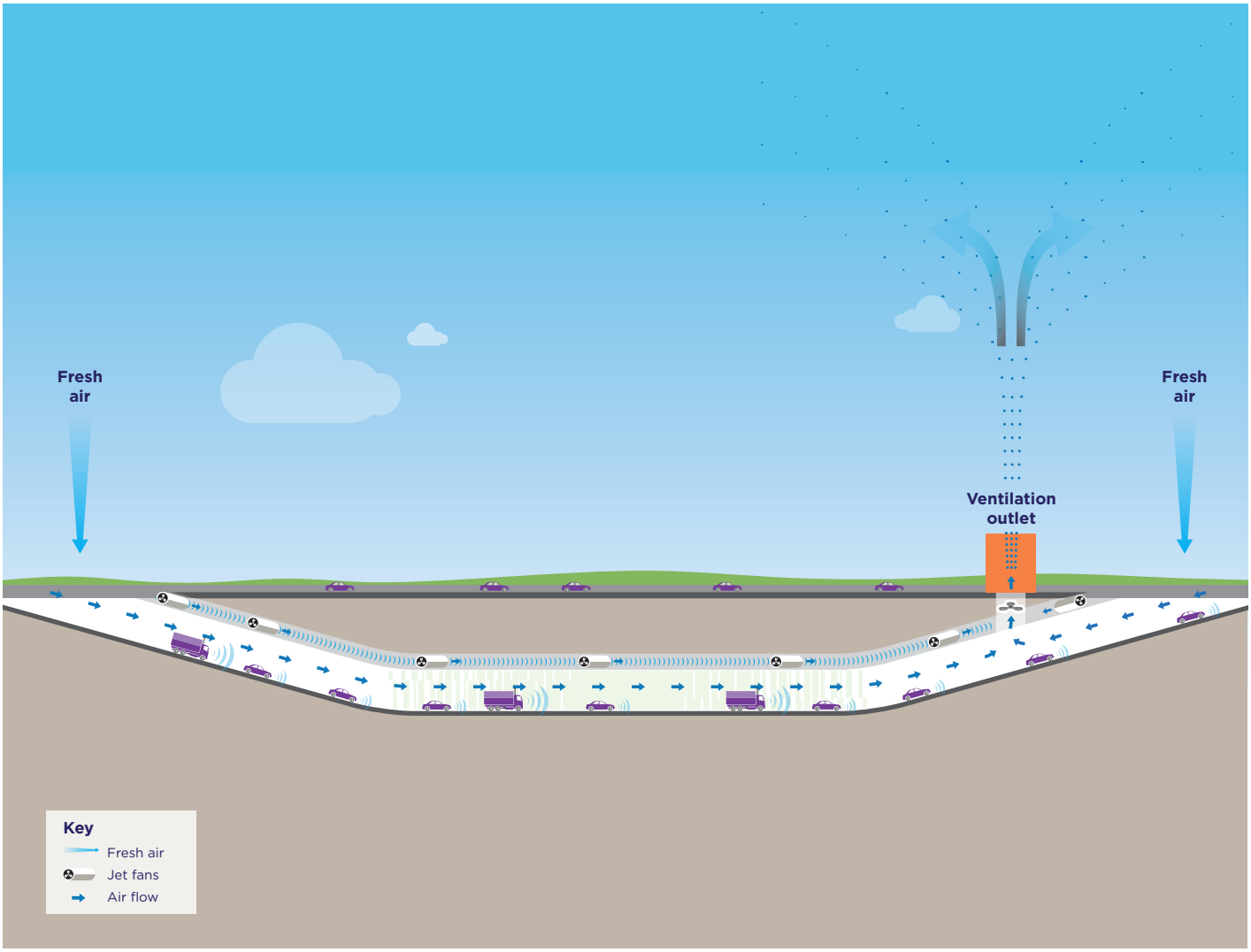
Portal emissions

Recent NSW tunnels longer than one kilometre are required to have zero emissions from portals, whereas outside Australia almost all road tunnels have portal emissions.

To achieve zero portal emissions, jet fans draw in air from the exit portal to ensure a net inflow of air at the portal so that all tunnel emissions are removed through an elevated ventilation outlet. This is most efficiently done when the ventilation outlet is positioned near the exit portal.

Ventilation outlets

Elevated ventilation outlets are very effective at ejecting tunnel air high into the atmosphere through a combination of buoyancy and speed. This occurs by the warmer tunnel air (heated by vehicles using the tunnel) being ejected upwards at speed through the outlet by axial fans. This warm air continues to rise high into the atmosphere through natural buoyancy as it is warmer than the surrounding air.



Modern tunnel ventilation ejects tunnel air high into the atmosphere

Once in the atmosphere, the ejected tunnel air dilutes hundreds of times as it mixes with the surrounding air and becomes indistinguishable from background levels.

The effectiveness of a ventilation outlet design in dispersing tunnel air under all operating and weather conditions is assessed through specialised computer modelling using actual hour-by-hour weather data for a full year.

Monitoring

Air quality within major NSW tunnels is now continuously monitored at the ventilation outlet to control the ventilation system. This ensures the strict limits outlined in the approval conditions are complied with at all times.

The ventilation outlets of all current and future operating motorway tunnels in NSW will require an Environmental Protection Licence issued by the NSW Environment Protection Authority. These licences will require tunnel operators to meet air quality limits and undertake air quality monitoring.

Since the Lane Cove Tunnel, air quality monitoring data is required to be made publicly available on the tunnel's website, which is a requirement of the approval conditions.

Reducing Emissions at the Source

The best approach is to continue to adopt cleaner fuels and vehicles to reduce emissions at the source, rather than attempt to filter them out of the air once they have been released.

Although there are more cars on the road, the developments outlined below have actually resulted in substantial reductions in total vehicle emissions in the past two decades. Total emissions from motor vehicles are set to continue to fall over the next decade due to the new cleaner vehicles replacing older technology vehicles. This is despite an expected increase in the number of cars in Sydney over the next 20 years as the population grows.

Current emission reduction initiatives and developments include:

- improvements in technologies and design e.g. electric powered vehicles
- clean fleet program
- smoky vehicle camera systems
- vehicle import duties on second-hand cars
- National Clean Air Agreement.

The NSW Government will continue to support initiatives to further reduce emissions at the source and monitor tunnel and roadside emissions to appropriately manage them.

Cars built after **2013** emit **97%** less oxides of nitrogen than vehicles built in **1976**

Diesel trucks built after **2011** emit **92%** less particles of matter than trucks built in **1996**

Tunnel filtration

Filtration technologies, otherwise known as 'air treatment systems', are intended to manage in-tunnel and ambient air quality.

There are two main types of filtration:

- Electro-Static Precipitation (ESP) – used to remove particulate matter (PM)
- De-Nitrification(Denox) – primarily used for the removal nitrogen dioxide (NO_2).

Why it's ineffective

Evidence to date suggests that the effectiveness of such controls, when applied to road tunnels, is limited to specific situations.

There are a number of limitations to the effective performance of filtration and other potential indirect impacts, including:

- technologies are pollutant specific – no combination of available air treatment systems is capable of removing all tunnel air pollutants and ventilation and dispersion is still required
- systems are only able to treat a very small proportion of vehicle emissions present in ambient air such that it has limited if any effectiveness in improving local air quality
- requires heavy investment in treatment equipment and additional ventilation capacity. Consequently, the systems are highly energy intensive and expensive to operate.

An international assessment of tunnel air treatment published in 2017 by the French Government indicated that there is a very small number of air treatment systems installed globally and of these few are routinely operated. This is due to concerns regarding effectiveness and limited benefits.

Sydney's experience with tunnel filtration

Experience from previous motorway tunnel projects in Sydney has demonstrated that emissions from tunnel ventilation outlets do not measurably affect local or regional air quality.

To gather firsthand information on tunnel air treatment, the NSW Government ran a filtration trial in the M5 East from March 2010 to September 2011. The filtration trial removed 200 kilograms of particles at a cost of $3.8 million per tonne (operating costs only). This is much less cost effective than a range of other particle reduction measures analysed by the then NSW Department of Environment Climate Change and Water (DECCW) and much more expensive than the calculated health benefits from removing this quantity of particles.

As such, repeated assessments have concluded that there is little to no health benefit for surrounding communities in installing tunnel air treatment systems.

Further reading

Road Tunnel Ventilation Systems
http://www.chiefscientist.nsw.gov.au

CETU (Cente d'Etudes des Tunnels) (2017)
http://www.cetu.developpement-durable.gouv.fr/IMG/pdf/cetu_di_traitement_de_l_air-en-19_07_2017.pdf

NHMRC (National Health and Medical Research Council) (2008).
www.nhmrc.gov.au/guidelines/publications/eh42

Climate Change Authority
http://www.climatechangeauthority.gov.au/reviews/light-vehicle-emissions-standards-australia/opportunities-reduce-light-vehicle-emissions

131 450

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For more information

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