OPENAIR

Operational Network of Air quality Impact Resources

Activities for impact compendium

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Table of Contents

Introduction

Local governments can implement a range of activities to engage with air quality issues at the local level. When planning an air quality monitoring project, it is important to consider which 'activities for impact' are realistic and possible for your organisation. In this context, 'activities for impact' are defined as data-driven activities that generate measurable outcomes.

If your project collects data, you need to have a clear sense of how you can act on data insights to make change, and how resourcing constraints or practical challenges might affect your options. Effective activities for impact related to air quality also require leadership buy-in and a broad commitment across your entire organisation (similar to other core organisational commitments, such as action on climate change or social equality).

This OPENAIR supplementary resource is designed to help you articulate your project's vision, carefully plan activities for impact, and secure widespread organisational support.

Who is this resource for?

This resource aims to assist people involved in the design and delivery of air quality initiatives to define their project's activities for impact, and to engage with staff and stakeholders within their organisation to expand the potential areas of impact.

It may be of interest to:

- people leading new air quality monitoring projects
- local government leadership
- strategic planners
- urban designers
- community engagement teams.

How to use this resource

This supplementary resource expands on information in the OPENAIR Best Practice Guide chapter *Activities for impact*. This resource provides a detailed compendium of activities that can be implemented by local governments to enhance air quality across four main impact areas:

1. Transport
2. Built environment
3. Green infrastructure
4. Community engagement

You can use this compendium to plan a core strategy for creating activities for impact that align with your organisational priorities and capacity, as the basis of your project design. This resource can also help you plan how to articulate and communicate the rationale behind your project to funders, senior management, project partners, or the wider community.

What is an activity for impact?

Activities for impact are initiatives that can be implemented or supported by local governments to leverage either the power of new data or associated processes of community engagement to create measurable outcomes that drive impact. A local air quality monitoring project is not in itself an activity for impact, but the data it collects, or the people it engages, can enable those activities (see Figure 1).

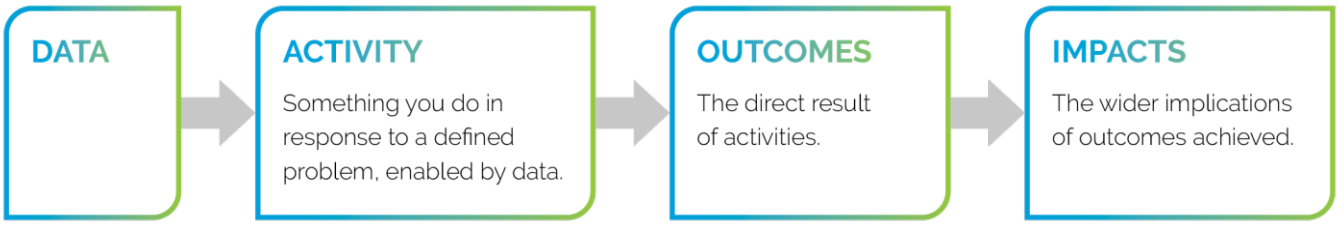


Figure 1. The pathway to impact creation

Identifying activities for impact

You should identify the activities for impact you plan to support during the early planning stages of a new air quality monitoring project. Your project can then be strategically designed to support these activities.

The activities you identify should align with your organisation's policy priorities and resourcing capacity. This will help you cultivate a broad commitment across your organisation to engaging with the issue, and ensure full leadership buy-in.

To identify appropriate activities for impact, consider:

Core categories

Air quality activities for impact can be grouped into three broad categories (see Figure 2). Each plays an important role within any comprehensive strategy designed to address an air quality issue.

Figure 2. Three core categories of air quality activities for impact

Direct agency vs advocacy

Local governments have many opportunities for direct agency on air quality, with the potential to create significant impacts. In general, however, they may have less direct agency where state government is the primary manager of an air quality monitoring activity. In these cases, local governments can use new data from their own air quality projects as a powerful tool to leverage wider advocacy outcomes.

Direct agency

Activities that are implemented or supported by local government must fall within local government jurisdiction or direct agency.

Examples include installation of cycling infrastructure in residential streets, green infrastructure policy, community engagement programs, or planning and development controls.

Advocacy

Activities that cannot be directly implemented or supported by local government may still be indirectly supported through advocacy.

Examples include advocating to state government for changes to major roads, or supporting community opposition to a potentially polluting development.

Time frames for impact activities

Local government engagement with air quality issues is a long-term commitment that requires action on a variety of fronts, and across several time frames (see Figure 3). You should review your options for activities across different time scales, starting with short-term actions that are easy to achieve, but planning for more complex medium- and long-term activities in parallel.

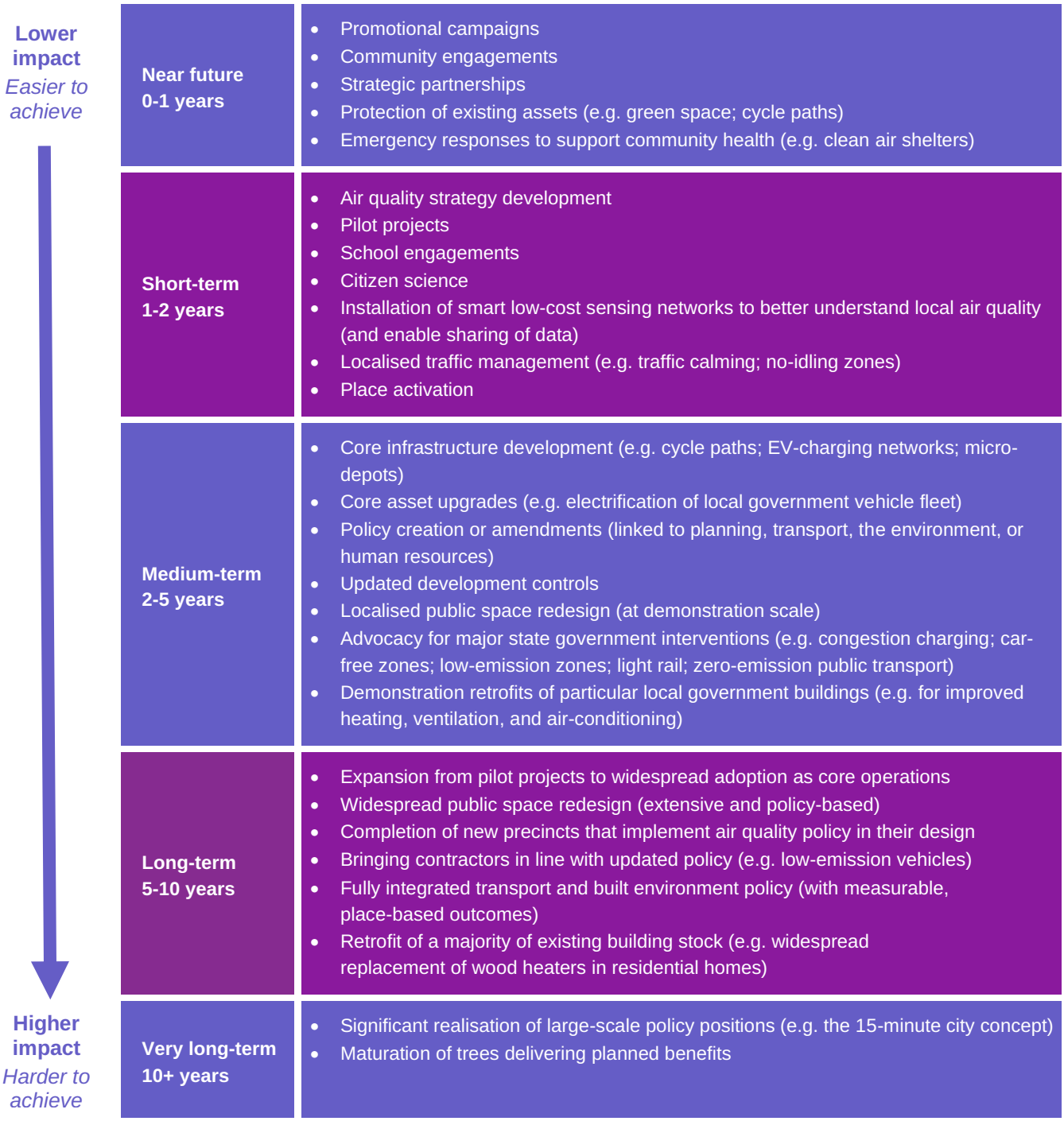


Figure 3. Time frames for potential activities for impact

Practical considerations and constraints

Once you identify a potential activity for impact, you should assess your ability to successfully implement it (and achieve the desired outcomes) by considering the practical constraints described in Figure 4.

Complexity/difficulty

Have you considered how complex the task is, and how difficult it may be to achieve your intended outcome?

It can be useful to think in terms of associated risk, the number of critical processes and stakeholders involved, or the number of extraneous governing factors.

Expertise required

Have you considered if you need specific expertise, knowledge, or skills (e.g. technical, domain-specific, or policy development) to implement the activity?

Time required

Have you considered how long it will take to achieve?

Consider internal processes for proposing and approving new activities; time frames required for implementation; and the time between implementation and any measurable outcomes.

Resourcing

Have you considered how much the activity will cost, and human resourcing requirements?

If there is an expectation that your air quality project delivers results beyond just collecting data, consider allocating some of your budget to activities for impact. For instance, your team may have the skills but lack the capacity to take on the extra work required to deliver impacts.

Measuring and monitoring

Have you considered how you will know if your project delivers its intended impacts?

Plan activities that can be measured, monitored, and reported. This can be vital to securing ongoing support for your air quality project.

Figure 4. Practical constraints to consider when choosing a suitable activity for impact

Impact area #1: Transport

Encourage and facilitate active transport

Separated cycle lane in NSW.

1. *Provide adequate, high-quality, safe, accessible, and well-connected infrastructure, facilities, and services for cyclists and pedestrians*

Why?

- Encouraging people to walk or cycle (rather than drive) reduces the number of vehicles on the road during peak hours, reduces emissions, and can alleviate pollution hotspots (e.g. at school drop-off zones).
- Infrastructure, facilities, and services are vital foundations upon which a cycling/walking community culture is built.

How?

- Develop, maintain, and expand a cycling network
- Provide plentiful and secure bike parking facilities
- Make streets or precincts pedestrian-friendly (or pedestrian-only)
- Design all new public spaces to prioritise pedestrians and cyclists
- Require new private developments to prioritise pedestrians and cyclists
- Design road intersections that prioritise pedestrians and cyclists
- Provide shelters, resting areas, water fountains, and other facilities.

2. *Deliver initiatives that support the uptake of active transport options*

Why?

- Local governments can support a significant shift away from private car use in favour of active transport by promoting, encouraging, and celebrating cycling and walking as safe, convenient, and appealing transit options.

How?

- Design high-quality wayfinding
- Provide route advice and maps
- Set up cycling proficiency and maintenance workshops and support facilities
- Run promotional campaigns, and participate in local events
- Create dedicated events and festivals (e.g. 'cycle to work' days)
- Facilitate partnerships with local businesses and the tourism, accommodation, and entertainment sectors to promote walking and cycling by customers and employees.

3. *Update transport policy to address air quality through an emphasis on active transport*

Why?

- Infrastructure and community engagement should be grounded in a city-wide transport policy that aims to reduce private car use, strongly prioritises active transport, and explicitly connects these positions to a commitment to good air quality.

How?

- The '15-minute city' is a transport planning and urban development strategy that aims to ensure people can meet their needs (related to work, living, commerce, health, education, and entertainment) within a 15-minute walk or bike ride from their homes.
- Transit-oriented development is a planning strategy that prioritises workplaces, housing, and amenities near transport hubs. It is an integrated approach to reducing the use of private cars that aligns with the 15-minute city concept by connecting active transport with public transport, land use planning, and zoning.

Implement measures to reduce the presence of motor vehicles in certain areas

1. *Advocate for congestion charging*

Why?

- Congestion charging occurs within a defined zone – generally the core of an inner city – where vehicles are charged for entry (with time-specific fees as an option) to discourage private car use.
- This strategy supports multiple outcomes, including reduced congestion; faster travel times; an inner city with more space for active and public transport; safer streets for cyclists and pedestrians; and improved air quality.

How?

- The London congestion charge (Transport for London, n.d.) requires motorists to pay to enter Central London between 7 a.m. and 6 p.m. Monday to Friday, and between 12 p.m. and 6 p.m. on weekends. The stated objective of this charge is to reduce traffic flow, as well as air and noise pollution.
- Local governments in NSW lack the jurisdiction to implement congestion charges, but they can advocate to the NSW State Government for their introduction.

A congestion charging zone sign in London, UK. Image source: Alena - stock.adobe.com.

2. *Implement car-free zones*

Why?

- Car-free zones are areas where the use of motor vehicles is low or non-existent, allowing places previously dominated by cars to be reclaimed for pedestrians and cyclists. This can significantly reduce vehicle-related emissions, and improve local air quality.
- There is strong evidence that car-free zones support vibrant local economies by increasing foot traffic and making places more attractive as destinations (Bliss, 2021).

How?

- It is not necessary to exclude all cars. For example, since 2016, the city of Barcelona in Spain has been working on the development of six *superilles* (or 'superblocks'), which are areas where car, lorry, bus, and scooter access is restricted to residents, essential services, or deliveries (O'Sullivan, 2020).

A car-free zone in Burwood, NSW. This space was transformed from a one-way road into a pedestrian precinct in 2022. Image source: UTS

3. *Advocate for the creation of low-emission zones (LEZ)*

Why?

- Low-emission zones (LEZ) and ultra-low-emission zones (ULEZ) are areas where access by certain polluting vehicles is forbidden or discouraged (with fines for non-compliance) to reduce air pollution.

How?

- LEZ have seen significant success in many global cities, such as Madrid and London. For instance, low-cost nitrogen dioxide sensors were used to measure the impact of a new LEZ in Madrid. Levels of this polluting gas were found to have diminished by 38% in the city centre, and by 9% in the whole city (Público [Public], 2019).
- While local governments in NSW do not have the jurisdiction required to implement LEZ, they can advocate for the NSW State Government to act on this issue.

Ultra-low-emission zone in England.

4. *Optimise freight strategy in dense urban centres*

Why?

- As straight-to-consumer and commercial freight increases (along with urban density), freight accounts for a significant – and growing – proportion of vehicle emissions.

How?

- Support strategic locations of freight distribution centres and micro-depots within the city, to reduce delivery trips and optimise journey efficiency
- Develop a pro-active policy to manage the growth of ‘gig economy’ delivery services.

Delivery truck in the Sydney CBD. Trucks can sometimes clog up city roads. Image source: UTS

Implement traffic management strategies

Suburban street in Australia with implemented traffic calming strategies.

1. *Implement traffic calming measures*

Why?

- Traffic calming in suburban streets, and in areas around vulnerable receptor sites (such as schools), can help to reduce 'rat-running' and encourage road use by local traffic only.

  Note that it is possible for such measures to backfire. Slower vehicles that need to constantly brake and accelerate can create more emissions than free-flowing traffic. The critical balance is that traffic calming measures should reduce the overall number of vehicles choosing to pass through an area, causing the net total of vehicle emissions to drop.

How?

- Measures may include reduced speed limits, lane reduction, speed humps, chicanes[1], or planting.

2. *Create no-idling zones around schools and other vulnerable receptor sites*

Why?

- These zones can reduce emissions in areas near school gates during school drop-off and pickup times.

[1] A serpentine curve in a road, designed to slow traffic.

How?

- Engage with school leaders, staff, and parents to build community support
- Define an area where no idling is allowed (and clearly signal fines for non-compliance)
- Ensure that compliance is enforceable
- Measure the impact on air quality using smart low-cost sensing devices.

No-idle zone in Seattle, USA. Image source: Creative Commons

3. *Introduce smart traffic light phasing to reduce the number of idling vehicles at pollution hotspot intersections*

Why?

- Adaptive or smart traffic light technologies can reduce the waiting time on red lights, and thus reduce the amount of air pollution created by idling traffic at an intersection. A longer period for green lights has been shown to reduce localised particulate matter pollution by up to 13% (Bhuiyan, 2015).

How?

- Basic systems utilise site-specific traffic counts to monitor traffic volume and idling time, adjusting traffic light phasing accordingly
- Wolverhampton (in the UK) is trialling smart, AI-powered traffic light technologies that incorporate traffic data from across the city, and combine it with localised weather and air quality data. Multiple intersections can be managed as a single system, holding vehicles back from pollution hotspots and preventing congestion. Machine learning applied to certain intersections can predict (up to an hour in advance) where and when a spike will occur (Macaulay, 2020).
- While local governments in New South Wales do not have the jurisdiction required to implement traffic light phasing, they can advocate for the NSW State Government to deliver pilot studies in their areas.

Smart traffic lights being installed in Fitzroy, Victoria. Image source: Cesar Nicolas, University of Melbourne

Support the widespread use of zero-emission vehicles

1. *Support the uptake of electric vehicles through providing proper facilities and incentives*

Why?

- The rapid uptake of electric vehicles (EVs) is currently one of the most promising – and proven – ways to improve urban air quality.
- The greatest barriers to EV uptake are affordability and practical convenience. EVs cost more to purchase, so incentives that improve the return on investment (e.g. free charging, or no tolls) encourage people to make the shift. Widespread, reliable, and conveniently located charging stations and parking options make owning an EV for day-to-day use far more appealing to community members.

How?

- Deliver public access EV-charging stations
- Require EV-charging facilities to be included in new developments
- Partner with private venues (such as shopping centres) to deliver integrated EV-charging solutions and public messaging
- Offer free parking for EVs
- Advocate for reduced or waived tolls for EVs
- Provide easy access to information about the location of charging stations
- Build a network of fast chargers at transport hubs, and on the edges of cities (close to highways), in acknowledgement of future mobility trends worldwide (as recommended by the World Economic Forum (Lombardi et al., 2018))
- Take inspiration from other similar projects, for instance, the City of Newcastle's E-Transit Hub solar-powered EV-charging station, which provides 100% renewable electricity to nearby sports fields (Local Government NSW, 2021)
- Use land use planning as a tool to encourage EV-charging in high-density residential, commercial, and industrial developments (as the City of Sydney is doing (City of Sydney, 2022))
- Install EV-charging facilities on public land, and encourage third parties to install charging stations (Hornsby Shire Council has implemented this strategy (Hornsby Shire Council, 2022)).

Electric vehicle charging in Glebe, NSW. Image source: Andy Roberts, courtesy of ISF/UTS

2. *Convert the local government fleet to zero-emission vehicles*

Why?

- Reduce air pollution produced in your city/town
- Reduce air pollution attributable to your organisation's activities
- Demonstrate the use of local government-funded facilities (such as an EV-charging network)
- Lead the wider community by example.

How?

- Allocate budgets for deployment and maintenance of EVs and charging infrastructure
- Work with member organisations (e.g. Local Government NSW) on EV-related advocacy

Local government electric vehicles in Lake Macquarie, NSW. Image source: Lake Macquarie City Council

3. *Favour contractors who use zero-emission vehicles*

Why?

- Local governments deliver a variety of common services via contractors, such as kerbside waste collection, street cleaning, or park and tree maintenance.

How?

- Develop procurement guidelines to prioritise the selection of contractors who use low- or zero-emission vehicles
- Communicate policy updates to existing contractors well ahead of contract renewal times
- Be inspired by similar initiatives. For instance, the City of Melbourne's *Emissions Reduction Plan for Council Operations 2021-2026* commits to increasing the adoption of low-emission and zero-emission vehicles, through the management of supply contracts related to waste collection, parks and gardens maintenance, towing, and street-cleaning vehicles.

A truck powered by hydrogen.

Advocate for zero-emission public transport

Why?

- The technologies for fully electric or hydrogen-powered buses are well-established, and are seeing widespread global uptake. These can enable the replacement of diesel buses, which are a major source of air pollution in inner cities.
- Light rail can form the core of an inner city transport strategy that sees broad removal of private vehicles from main streets and retail zones, coupled with widespread pedestrianisation.
- Diesel trains entering the inner city are another significant source of air pollution, particularly around major train stations.

How?

- Advocate for prioritised phase-in of zero-emission buses on specific routes that pass through air pollution hotspots (keeping in mind that bus fleet replacement tends to occur in phases).
- Advocate for light rail, and work with state authorities to support its delivery (successful examples in NSW include the City of Sydney, City of Parramatta, and City of Newcastle light rail systems, all of which were built in the past decade).
- Train fleets can be converted to fully electric or diesel-electric hybrids, removing the use of diesel in the inner city.

Light rail in Sydney, NSW. Image source: City of Sydney

Impact area #2: Built environment

Require new developments to prioritise active and public transport

Why?

- As urban density increases, it is important to design new residential and commercial developments that prioritise active and public transport, and limit private car use. This can reduce the number of vehicles on the road in surrounding areas, improving local air quality.

How?

- Ensure that controls for all new developments incorporate public transport connections, and active transport infrastructure and facilities, as a critical requirement.

End-of-trip bike facilities at an office to incentivise staff to ride to work in Ultimo, NSW. Image source: UTS

Limit the number of parking spaces for cars

Why?

- Limiting the number of car parking spaces in town/city centres encourages people to use alternative forms of transport (provided those alternatives are available, accessible, reliable, and appealing)
- Restricting the total number of car parking spaces available in new residential developments encourages households to reduce car ownership, thus reducing vehicles on the road and supporting greener, quieter, and more walkable streets in the vicinity.

How?

- Update local government street design policy to reduce car parking facilities in favour of wider footpaths, cycle paths, and planted strips
- Update development controls for new inner city residential developments to reduce car parking spaces.

Shared zone for cars and pedestrians in Leichhardt, NSW (with only one car space provided). Image source: UTS

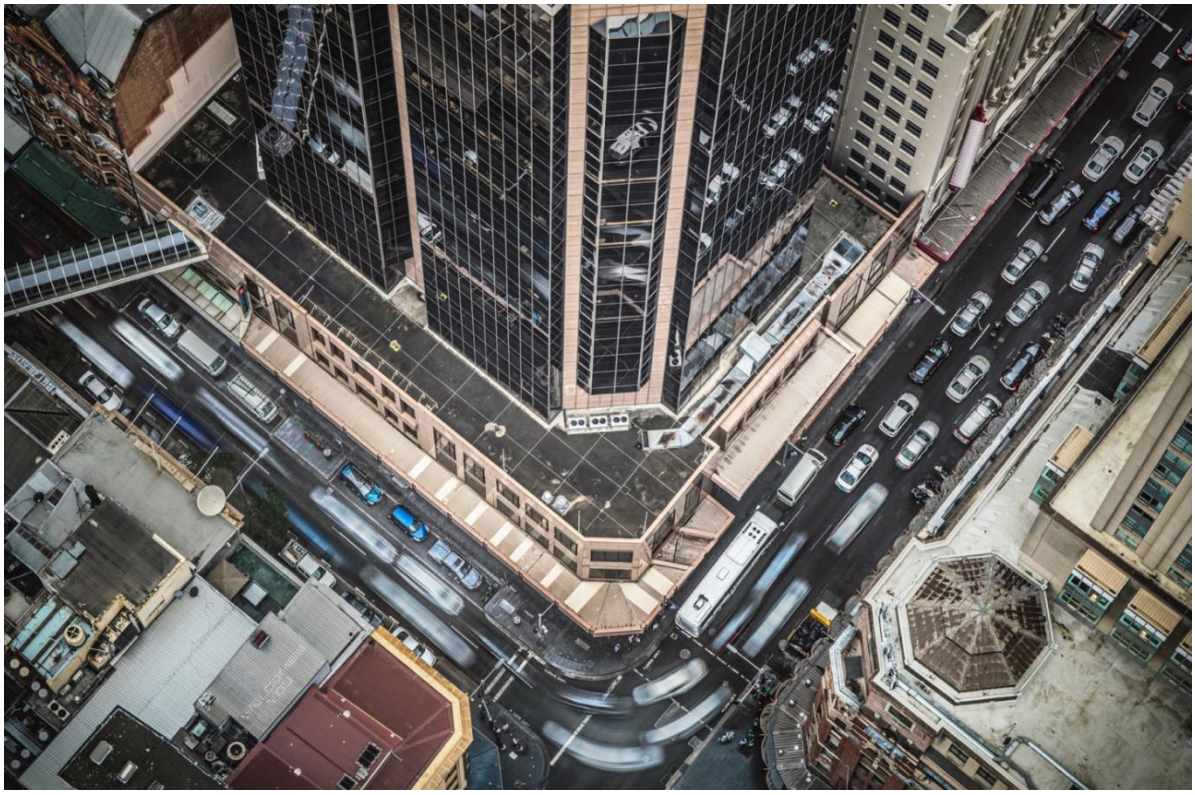
Reduce the street canyon effect and its negative impact on people

Why?

- Street canyons can have poor air circulation, resulting in vehicle emissions building up to levels much higher than the ambient background air quality. This has direct implications for pedestrians and cyclists. Ventilation systems for buildings that face the street also draw air from these canyons, raising concerns about indoor air quality and health impacts.
- The higher, narrower, and longer a street canyon is, the greater the potential problem it poses in terms of negatively impacting local air quality.
- Prevailing wind direction makes canyon orientation important (e.g. canyons at an angle to the wind experience poorer air quality than those that are aligned with prevailing winds).
- Particularly poor air quality can result from diesel bus routes that pass through street canyons, which is a common phenomenon in the inner city.
- Trees in street canyons can make air quality worse by trapping pollution underneath their canopies.

How?

- Update zoning policy relating to building heights and street widths to consider street canyon effects and air quality impacts
- Advocate to state transit authorities for the relocation of diesel bus routes out of street canyons, or phasing in zero-emission bus routes
- Update street tree policy for street canyons, as certain tree species may be inappropriate
- Use green walls as an option to mitigate pollution in street canyons (but note that this depends on the species used, pollution levels, and other local factors) (Ysebaert et al., 2021)
- Incorporate air quality design approaches into development controls (for instance, mitigate exposure to poor air quality for people living or working in buildings along street canyons by locating living areas, outdoor spaces, and air intakes on building sides that do not face street canyons with high pollution levels).



A street canyon in Sydney, NSW.

Limit the exposure of vulnerable receptors to air pollution

Why?

- Vulnerable receptors are locations with groups of people who are most vulnerable to the health impacts of poor air quality, such as schools, childcare centres, aged care facilities, and hospitals.

How?

- Require Development Applications (DAs) for new vulnerable receptor sites to include consideration of local air quality and pollution sources prior to receiving approval
- Design planning policy to ensure that facilities known to create pollution are not built anywhere near vulnerable receptors.

Vulnerable receptor sites (such as this childcare centre in Leichhardt, NSW) can be adversely impacted by air pollution. Image source: UTS

Update policy and guidelines related to the control of dust on construction sites

Why?

- Construction creates dust, which can spread to surrounding areas if not properly controlled. In urban locations, large construction sites – which can be operational for years – are often located directly adjacent to residential precincts, places of work, or vulnerable receptor sites, posing a direct risk of particulate matter pollution.
- Existing dust control measures are not always adequately informed by data, and may not be as effective as assumed. Local conditions can result in unique processes and effects that need to be better understood.

How?

- Update policy, guidelines, and dust control measures to be in line with broader local government commitments to addressing air quality issues, and use new data to refine and strengthen these measures. Note that in NSW, local governments (together with state EPA authorities) are responsible for issuing and enforcing controls on construction site dust.

Sensing devices installed to monitor dust at a construction site in Parramatta, NSW. Image source: UTS

Address diesel emissions from backup generators

Why?

- Most large city buildings have at least one backup generator (BUG). Data centres may have as many as 200 (and there are at least 15 data centres within the City of Sydney LGA; (Google Maps, 2023). Almost all current models of BUG operating in NSW use diesel, which creates high levels of air pollution.
- The NSW Government has identified the air quality impact of BUGs as a major concern (Todoroski Air Sciences Pty Ltd, 2021).
- Bushfires are a leading cause of large-scale power outages in NSW (Origin, 2019). Bushfires can also create smoke inundation events, resulting in urban air pollution levels many times over recommended safe levels. This means that bushfires can trigger the simultaneous activation of all BUGs within a locality at a time when there is already very poor air quality due to smoke.

- BUGs need to be tested every six months. This is usually done by a contractor operating within normal business hours, which means that testing may occur at a time that coincides with heavy traffic or school hours (or with more extreme events, such as bushfire smoke inundation). Testing times should be selected to minimise community impact, but this is not yet common practice.

How?

- Ensure that approval of new data centres requires an air quality impact assessment
- Require backup generators to be installed with consideration of nearby vulnerable receptors (e.g. position exhausts as far away from receptors as is feasible)
- Advocate for low-emission BUGs and/or large batteries as an alternative to more traditional diesel options (and consider the possibility of mandating their use in all future developments)
- Explore the extensive list of recommendations in the NSW Department of Planning, Environment and Industry's report *Air Emissions Control for Back-Up Power Supplies for Data Centres and Other Land Uses* (Todoroski Air Sciences Pty Ltd, 2021).

Most commercial buildings have at least one backup generator in their basement, and larger buildings may have several.

Incentivise the uptake of energy-efficient technologies in homes

Why?

- Energy-efficient homes that are well-insulated, and use passive design and technologies such as heat pumps, can reduce the use of air conditioners. Air conditioners pump hot air out of buildings and into city streets and in large numbers they can contribute to the urban heat island effect. Hotter temperatures increase air pollution, and worsen its impact on human health.
- Heat pumps are an ideal alternative to the use of wood heaters, which are a major source of air pollution in many communities. When combined with energy-saving technologies (such as solar power and batteries), heat pumps can be an affordable and accessible alternative to wood heaters for lower-income households.

How?

- Promote to your local community all state government incentives (such as rebates, subsidies, and tax breaks) that encourage the adoption of energy-efficient home technologies – from better insulation to rooftop solar – by reducing residents' capital outlay
- Form strategic partnerships with universities, technology companies, and state authorities to support adoption of energy-efficient technologies in local homes
- Explore creating grant and funding opportunities to motivate your community and harness external support (particularly if a project targets marginalised groups, such as Indigenous communities, or people in social housing)
- Conduct research to understand existing housing stock, as well as the behaviour and motivations of homeowners, to develop targeted and effective campaigns to spur adoption of these technologies by residents
- Use smart low-cost sensing devices to understand hyper-local spatial and temporal distributions of wood smoke (if this is a focus of your project) to help target your messaging and engagement in areas associated with wood burning.

Energy-efficient homes with draught-proofing help to reduce the need to heat/cool homes using polluting wood heaters or air conditioners.

Impact area #3: Green infrastructure

Update green infrastructure strategy to support improved air quality outcomes

1. Understand how trees impact local air quality, and update local government policy accordingly

Why?

- Some tree species are better than others at capturing and actively reducing air pollution, so you need to make sure you plant the appropriate species, and seek up-to-date research related to this issue.
- Some tree species can make air pollution worse in certain contexts, for example:
  - Pollen is particulate matter that's less than 10 micrometres in size (PM_{10}), which can trigger hay fever and asthma (NSW Health, 2020).
  - Biogenic volatile organic compounds (BVOCs) are produced by some tree species, particularly during hot weather. BVOCs react with nitric oxide (NO) from vehicle emissions, which has the net effect of elevating ground-level ozone (O_3), which negatively impacts human health. At ground level, ozone can trigger a range of acute health impacts such as coughing, shortness of breath, asthma or bronchitis symptoms.
  - Certain planting configurations can trap air pollution beneath tree canopies, an effect that is at its worst in deep street canyons.

How?

- Find out which common street trees in your area are 'good' or 'bad' for local air quality, and incorporate this research into broader air quality management strategies
- Use smart low-cost sensing devices to gain direct insights into how trees behave in your locality, with its particular combination of climate, soils, and topography (e.g. do a comparative study of air quality in locations with different tree species, but similar background conditions)
- Review and update tree-planting guidelines, as well as policies relating to street trees, development consent, and public space design.

A tree-lined street in Leichhardt, NSW. Image source: UTS

2. *Plant strategically near major roads to block pollution dispersal or clean the air*

Why?

- Vegetation can sometimes form useful physical barriers to the wider dispersal of vehicle emissions near roads, especially planting regimes that favour low, dense hedges and shrubs.
- Studies indicate that green walls can contribute significantly to the reduction of particulate matter pollution by acting as a filter alongside dense and polluted streets (Pugh et al., 2012).

How?

- Conduct research and/or use smart low-cost sensing devices to understand how different, locally appropriate plant species and planting strategies can form effective pollution barriers, and explore this as a strategy for separating people from pollution hotspots
- Conduct research to assess the use of green walls for pollution mitigation, and encourage wider use of green walls for this purpose.

Strategic location of dense plants alongside busy roads can help to form a physical barrier that prevents the dispersal of air pollution.

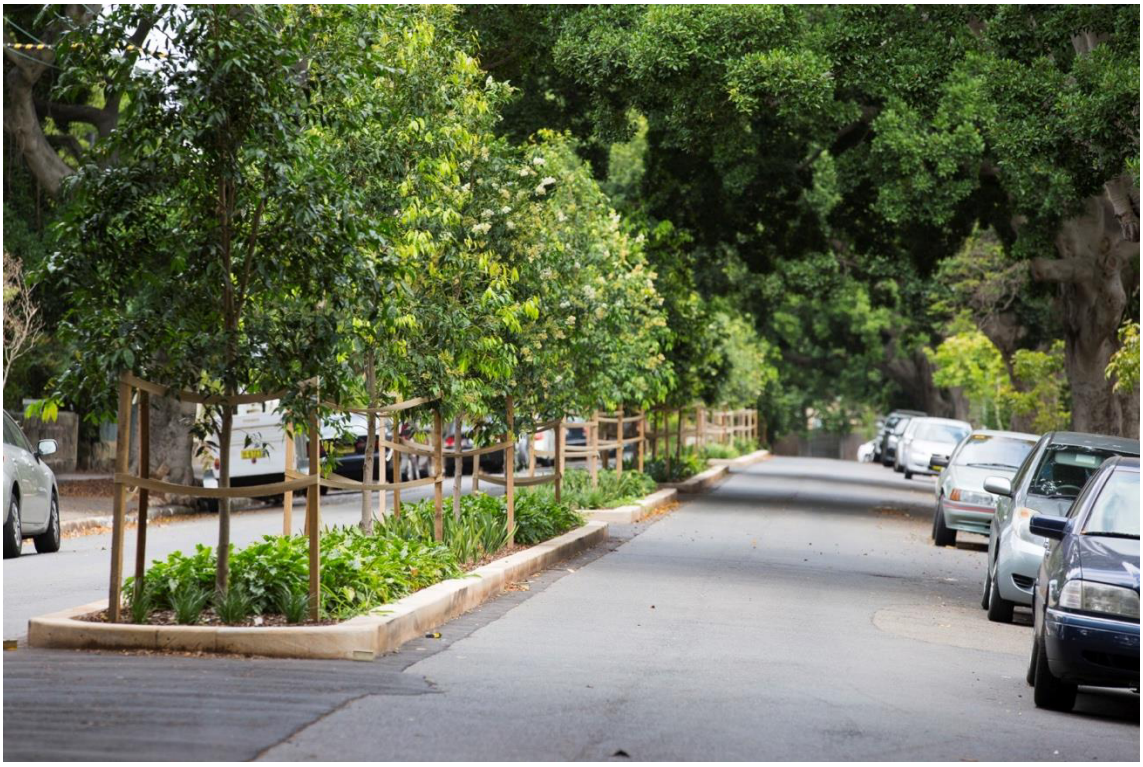
3. *Use urban greening as part of a broader strategy to reclaim streets from cars*

Why?

Reducing pollution at its source is the most effective way to address air quality issues. Trees and nature strips can be used as part of broader streetscape redesigns that reduce traffic, and result in improved local air quality.

How?

- Ensure you have a local government urban greening strategy that notes the role of greening in improving public health, and the health and amenity of the local environment (and ideally also makes reference to the role of greening in improving air quality)
- Ensure that this urban greening strategy is closely connected to transport and planning policies, with aligned aims and explicit mention of air quality across all areas
- Develop demonstration streets to trial and showcase more progressive and effective greening strategies.



A residential street with significant tree canopy in Sydney, NSW. Image source: City of Sydney

4. *Use green infrastructure to reduce the urban heat island effect*

Why?

- Plants can increase shade and reduce the area of concrete and asphalt surfaces exposed to direct sun. Plants can also actively cool the air, through a process called ‘evapotranspiration’. As a result, greener places have lower ambient temperatures during very hot weather (often by as much as several degrees Celsius).
- Heat mitigation directly improves air quality, as lower temperatures reduce the formation of ground-level ozone, thus reducing the health impacts of air pollution.

How?

- Set targets for tree canopy coverage, planted areas, and permeable surfaces in public spaces and in all new private developments
- Understand the relative cooling impact of different tree/plant species in your local region
- Ensure that trees remain healthy and well-watered for optimal cooling, and avoid tree species that might create air pollution.

Parklands (like Bicentennial Park in Sydney, NSW) mitigate the urban heat island effect. Image source: © Sebastian Pfautsch, Western Sydney University

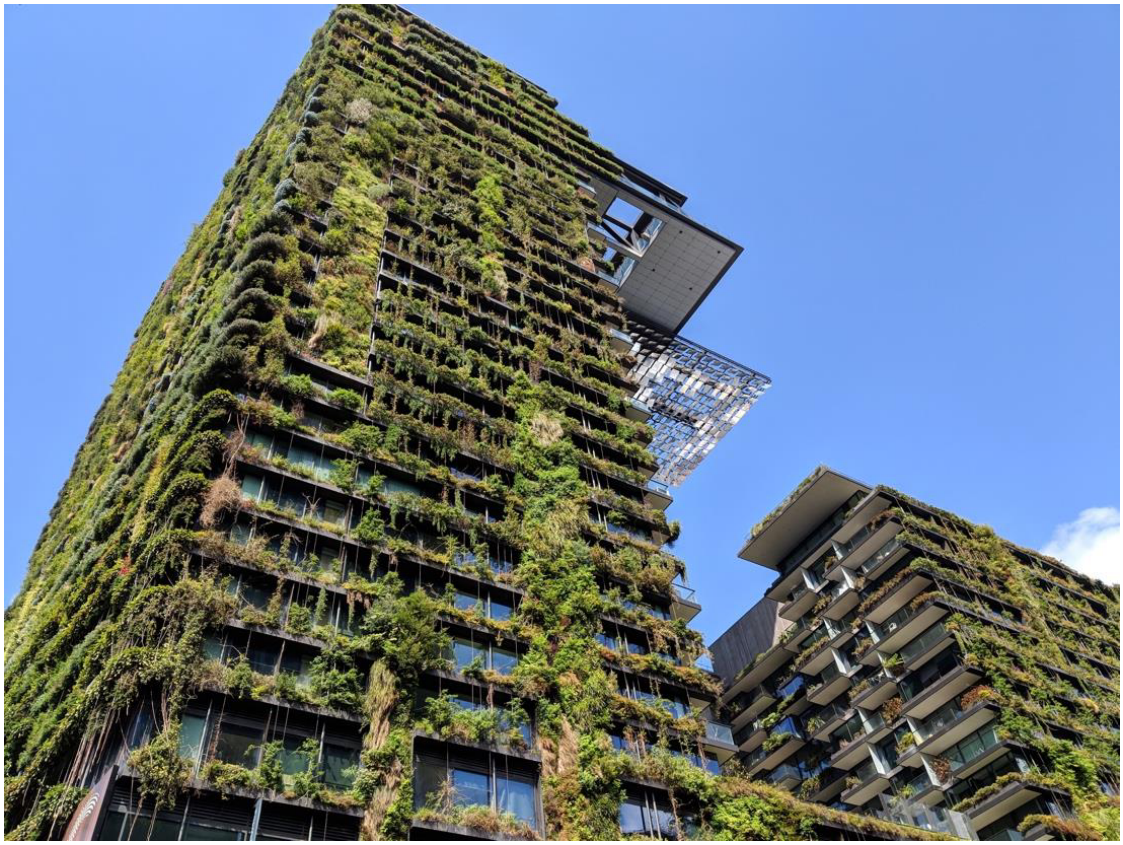
5. *Update development controls to support greener buildings and developments*

Why?

- Green infrastructure can directly improve air quality and reduce the urban heat island effect at the local scale. Existing development controls and design guidelines may lack a strong grounding in evidence of these benefits of greening, and may not be optimised to deliver the best results on air quality and urban heat mitigation.

How?

- Use new insights from smart low-cost sensing projects to inform urban greening design strategies that can be incorporated into planning controls and green infrastructure targets
- Prioritise certain types of green infrastructure that are proven to be most effective
- Introduce new guidelines for best practice design (e.g. optimal green wall construction; vegetation height; minimum park size; and optimal aspect for cooling and cross-winds).



Green walls (like this one in Sydney, NSW) can actively clean pollutants from the air.
Image source: Creative Commons

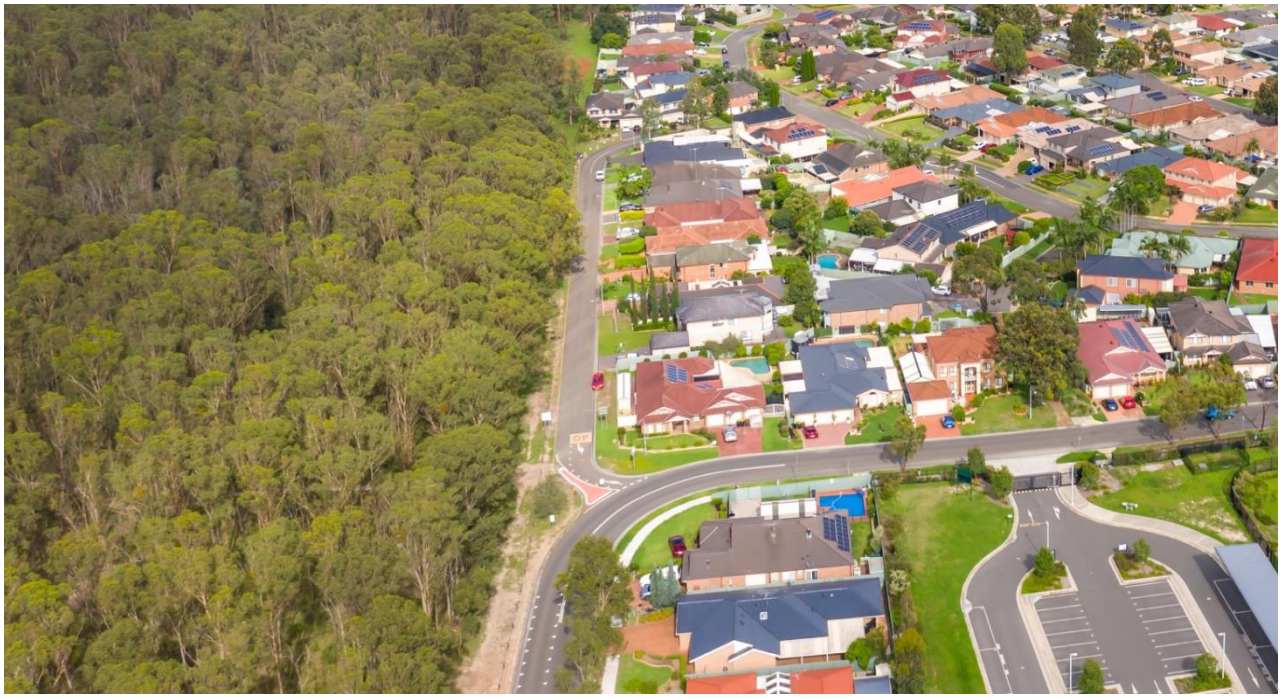
6. *Protect existing green infrastructure*

Why?

- The most valuable green infrastructure is the green infrastructure your local area *already* has. Air quality and urban heat concerns add weight to existing arguments for actively protecting green spaces in towns and cities.

How?

- Conserve existing green space, mature trees, and remnant bushland as a vital part of your urban greening strategy
- Tighten development controls to support efforts to conserve and protect green space.



Encroachment of suburban residences into existing bushland in Western Sydney, NSW.

7. *Support equitable distribution of green infrastructure*

Why?

- Air quality and urban heat are environmental justice issues, and it is vital that local government policy recognises this, and seeks to redress inequity.
- Green infrastructure is often unevenly distributed, with wealthier coastal suburbs tending to be cooler and greener, and inland suburbs (such as many areas of Western Sydney) experiencing a significant lack of green infrastructure. The social division between these two types of location tends to be along socio-economic lines. A disproportionate number of low-income, Culturally and Linguistically Diverse (CALD) communities, and Indigenous communities live in places with low tree cover and poor access to extensive, healthy green spaces.

How?

- Prioritise urban greening in the communities that need it most, and use new data to update spatial maps measuring green coverage to ensure equitable access (through policy or other initiatives)
- Give the public easy access to this information about green coverage, and engage stakeholders and communities to help inform decisions related to wider greening strategies
- Regularly review policies and initiatives that relate to urban greening to ensure green spaces are equally accessible to all.

New housing developments (like this one in Western Sydney, NSW) have been criticised for not creating enough green infrastructure for residents.

Impact area #4: Community engagement

Implement measures that directly support the health and well-being of people by engaging communities on air pollution issues

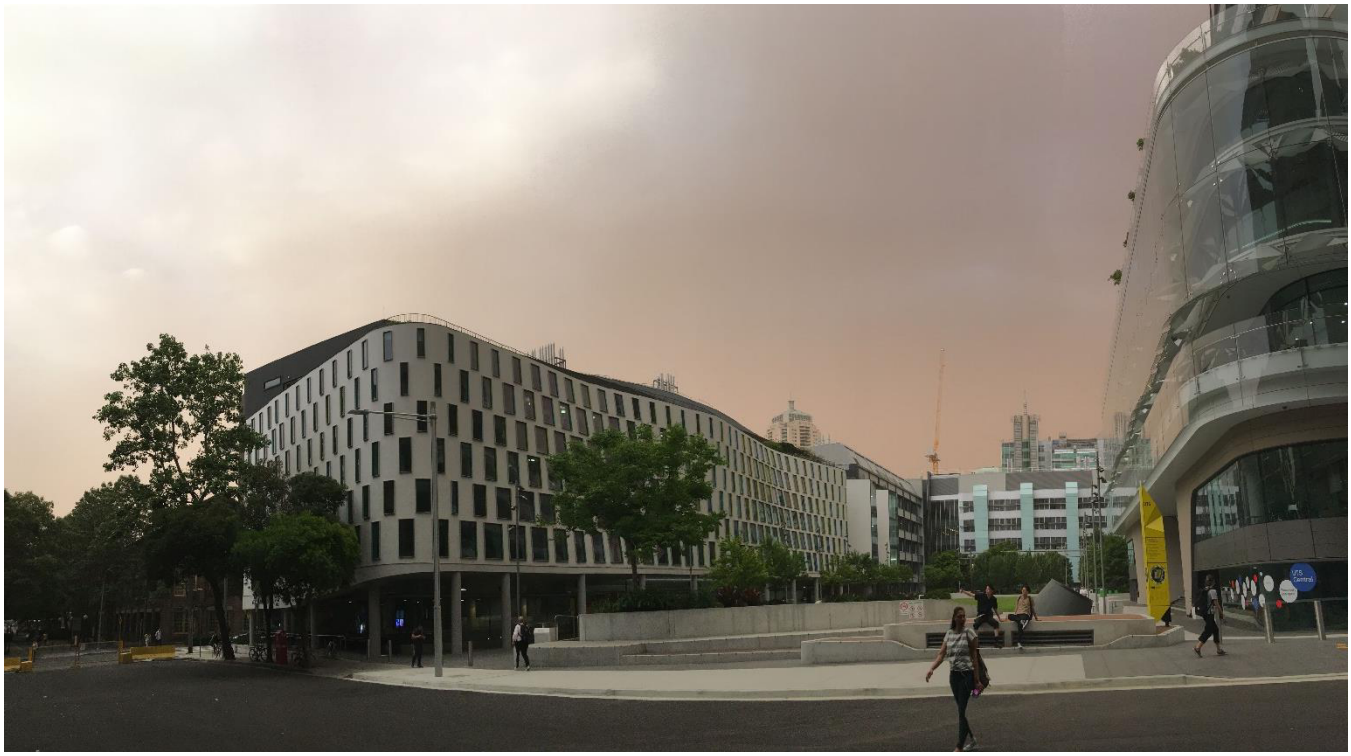
1. Provide communities with information, advice, and support during bushfire smoke events

Why?

- Bushfires create air pollution that can be many times above recommended thresholds, posing a risk to everyone in the community. Massive bushfires in recent years in Australia have shown how smoke events can be extreme and prolonged. Climate projections indicate that such events are likely to become more frequent – and more extreme – in the coming years.
- Vulnerable populations (e.g. children, the elderly, or people with chronic illness) need to be given advance warning of smoke events, clear and practical advice, and direct support via existing services to ensure their well-being during extreme smoke events.
- Local governments work at the front line of communities during emergency events, and should be prepared to issue appropriate information, advice, and support relating to bushfire smoke and public health measures. This should align with existing public services delivered by local government.

How?

- Make reliable, local air pollution data available to the public through the use of smart low-cost sensing devices
- Follow the recommendations to provide community access to hourly, near-real-time, location-specific particulate matter pollution data, and reliable smoke forecasts, as part of a proposed bushfire smoke national health protection strategy (Vardoulakis et al., 2020)
- Review the risk posed to normal operations of critical front line services that support vulnerable groups during bushfire events
- Consider how front line services can help to communicate critical information and advice
- Develop simple and clear resources translated into community languages (and made available via other formats, like large type or audio) to make information accessible to all community members, drawing on global best practice for communicating public health advice (see the resources included in NCEPH, 2020).



In 2019, bushfire smoke in Sydney, NSW posed a major health risk to vulnerable populations. Image source: UTS

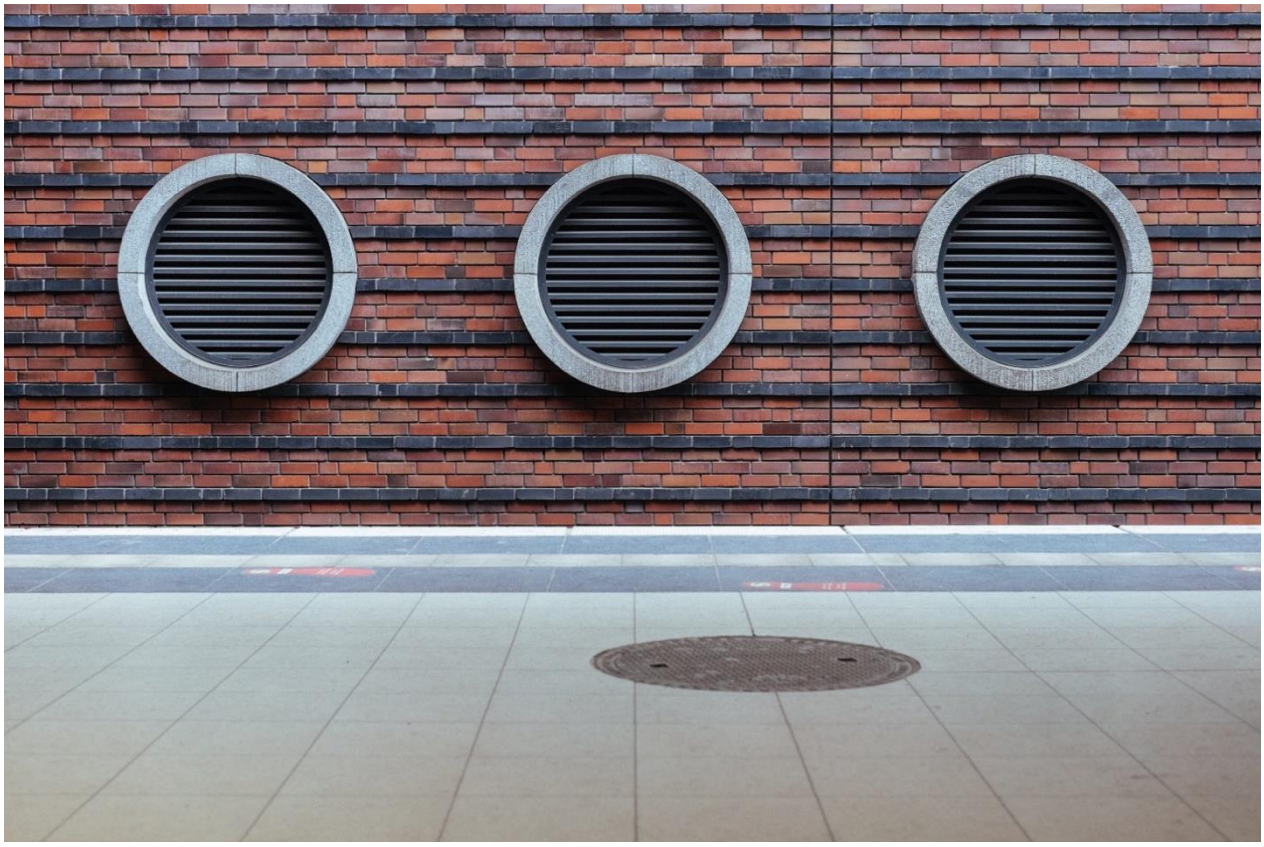
2. *Upgrade local government buildings to better protect people from outdoor air pollution*

Why?

- During bushfire smoke events, standard health advice includes telling people to remain indoors. However, outdoor air pollution can infiltrate many buildings, leading to indoor air pollution that exceeds recommended thresholds, posing a health risk to occupants. The effect is smaller, but still significant, for other forms of air pollution, such as vehicle emissions during peak hour traffic.
- Many heating, ventilation, and air conditioning (HVAC) systems are not suitable for cleaning air of fine particulates in line with best practice. They may lack the correct high-efficiency particulate air (HEPA) filters; filters may be dirty and require replacing; the system may lack the power and capacity to support HEPA filters; or ducting may lack the structural integrity required for recommended airflows and pressures. Furthermore, the building itself may not have a reliable power supply to support prolonged use of HVAC, particularly with the high risk of grid power outages during bushfire events.
- Many older buildings are ‘leaky’, allowing high infiltration of outside air through gaps in walls, windows, doors, and roofs.
- Many buildings have ventilation systems that do not register elevated outdoor air pollution, operating under an assumption that outside air is always ‘fresh’ air.

How?

- Audit HVAC systems in local government buildings to measure existing performance and capacity
- Undertake micro-studies of indoor/outdoor air quality in local government buildings to gather data and insights
- Regularly clean air filters and air ducts
- Upgrade HVAC systems, and reduce building 'leakiness' using lower-tech measures (such as installing draught-excluders or new windows)
- Prioritise retrofits of buildings that might be suitable as community clean air shelters
- Update the air intake schedule for a building to avoid periods of high outdoor air pollution, such as during peak hour traffic (see (MacNeill et al., 2016).



Building ventilation systems can be optimised to prevent outdoor air pollution from entering indoor spaces. Image source: Image source: Creative Commons

3. *Develop HR policies that protect local government staff from poor air quality*

Why?

- If outdoor air pollution rises above recommended thresholds, a direct health risk is posed to people working in that environment. This is a relevant concern for local governments, who often employ many staff who work outdoors for prolonged periods.
- Outdoor air quality directly impacts indoor air quality, particularly in older buildings. This means that staff working indoors may be exposed to harmful levels of air pollution during more extreme conditions (such as bushfire smoke events). Staff who work indoors also need to travel to their place of work, which increases their risk of exposure.

How?

- Ensure that you have access to reliable, real-time, local air quality data, and to accurate, short-term air quality or smoke level forecasts (if possible)
- Engage with your HR department to explore the possibility of a new occupational health and safety policy (e.g. establishing air quality thresholds for 'downing tools'), noting that a precedent already exists for extreme heat events
- Consider your organisation's work-from-home policy during very poor air quality events (such as extreme bushfire smoke), and give staff the option to choose to work from home where possible, as a way to minimise their exposure to air pollution.

Outdoor workers can be directly exposed to poor air quality and extreme heat.
Image source: Lake Macquarie City Council

4. *Establish community clean air shelters*

Why?

- Bushfires can cause extreme and prolonged smoke inundation events in populated areas, as experienced in NSW and Victoria during the Black Summer of 2019-2020. Evidence suggests that high-efficiency particulate air (HEPA) filters can effectively clean indoor air during these events, if used correctly.
- Giving the community access to a facility with clean air, or to a public building with good indoor air quality, is recommended as part of a broader national bushfire smoke health protection strategy (Vardoulakis et al., 2020). A community clean air shelter (CCAS) is a large public building (e.g. a library, public hall, or gymnasium) that either has a well-maintained HVAC system with HEPA filters, or is able to run one or more portable air filtration systems with HEPA filters.
- During the 2018-2019 bushfires in south-west Tasmania, the Huon Valley Council established ad hoc emergency 'clean air rooms' to give vulnerable people respite at their main evacuation centre (Keating & Handmer, 2021).
- A 2019 air quality research project carried out in a public library in Port Macquarie, NSW showed that running a HEPA filter made indoor particulate concentrations 83% lower than outdoor concentrations (Wheeler et al., 2021).
- The British Columbia Centre for Disease Control in Canada recommends that local governments establish community clean air shelters as a response to wildfire emergencies (Barn, 2014). The City of Vancouver, for instance, established multiple clean air shelters for the public during wildfire events in 2017, 2018, and 2020 (Hasegawa, 2020; Sorathiya, 2020).

How?

- Make sure that there are several CCAS in your local government area, so that people can seek refuge during extreme bushfire smoke events to avoid prolonged exposure to unhealthy concentrations of smoke
- Assess the suitability of existing HVAC systems and electrical power supply, consider building upgrades, and make concrete plans for designated CCAS venues well before emergency conditions arise
- Broadly promote to your local community the location and availability of CCAS, and address any accessibility requirements for less mobile or vulnerable people.

An air quality research project conducted in Port Macquarie Library in NSW showed the positive mitigation effect of HEPA filters. Image source: Port Macquarie-Hastings Council

5. *Support the retrofitting of homes to better protect people from bushfire smoke*

Why?

- A majority of people remain inside their homes during extreme bushfire smoke events, in keeping with official public health advice. However, evidence suggests that this approach can have mixed outcomes because many homes are not properly protected from infiltration of outdoor pollution.

How?

- Low-cost retrofits (e.g. using draught-excluders or draught-proofing) can significantly reduce the 'leakiness' of homes, and stop air pollution from getting indoors
- Upgraded air conditioners with good filters make a big difference, and may have the added benefit of being more energy-efficient
- Local governments currently support home energy-efficiency retrofits through a variety of mechanisms (including educational programs and financial incentives); following the Black Summer bushfires in Australia, experts emphasised the need for a similar focus on home air quality retrofits (Davey, 2019).

A low-cost, simple draught-excluder can be used to prevent the ingress of bushfire smoke into homes, and to limit hot/cold air leakage. Image source: Jenny - stock.adobe.com

Encourage behaviour change

6. Increase public awareness of air quality by sharing real-time information

Why?

- By increasing community awareness of air quality, local governments can empower people to understand and actively engage with an issue that directly impacts them, and also build a community mandate for action on air quality.
- Public awareness supports behaviour change towards less polluting activities, and encourages people to be proactive in minimising their exposure to air pollution.
- Community engagement with air quality issues builds a base for potential grassroots advocacy.
- When your community has access to real-time information about air quality in the local area, they can choose to minimise their exposure to pollution at particular places and times. This especially supports vulnerable groups (e.g. asthma sufferers, children, or pregnant women).
- Sharing air quality information in real time is also one of the best approaches to supporting public health and well-being during bushfire smoke events.

How?

- Deliver educational programs, events, or resources that increase public understanding of air quality, how it is measured, and the impact it has on health and well-being.
- Use smart sensing technologies to enable the sharing of real-time, hyper-local air quality information with the public through dashboards, apps, live data streams, automated alerts (via SMS or social media), and data-activated installations in public spaces.
- Aim to provide hourly or sub-hourly local data that is as accurate as possible.
- Take the time to understand and trust your own data before you share it with the public, even if this means running your new sensing network for a prolonged trial period (and ensuring data quality and accuracy) before you release the data more widely.

Engaging communities on air quality issues is key to positive behaviour change. Image source: City of Sydney

7. Deliver effective behaviour change campaigns

Why?

- Many local air quality issues result from the combined behaviour of many individuals (e.g. driving a car, or using a wood burning heater). However, people tend to be open to changing their behaviours if new, compelling reasons and incentives are brought to their attention.

How?

- Engage in research to understand how certain behaviours create air pollution in your local government area, and the motivations behind those behaviours
- Use this new knowledge about public behaviour patterns to strategically incentivise behaviour change in the places where it can make the biggest difference to air quality.

Residential wood burning can be addressed through public engagement campaigns to reduce smoke impacts. Image source: UTS

Support citizen leadership

1. Directly support community action

Why?

- Air quality is an environmental justice issue: it matters first and foremost in terms of its impact on people, and it does not impact all people equally. Lower-income and minority communities are disproportionately impacted because they tend to live closer to pollution sources, in places with less green infrastructure, low-quality urban design, and fewer public services.
- All communities can be negatively impacted by air pollution and deserve support for any citizen-led actions that advocate for a cleaner, healthier environment.

How?

- Position citizens as leaders of change by adopting participatory design practices that involve community members in local air quality education, measurement, and action
- Support citizen sensing initiatives, where community members are supported to capture and share air quality data using their own smart low-cost sensing devices
- Support interpretation and analysis of publicly available air quality data in ways that support community agendas
- Contribute institutional resources and legitimacy to community-led advocacy on air quality.

Protest against WestConnex in Sydney, NSW. Image source: No Westconnex: Public Transport

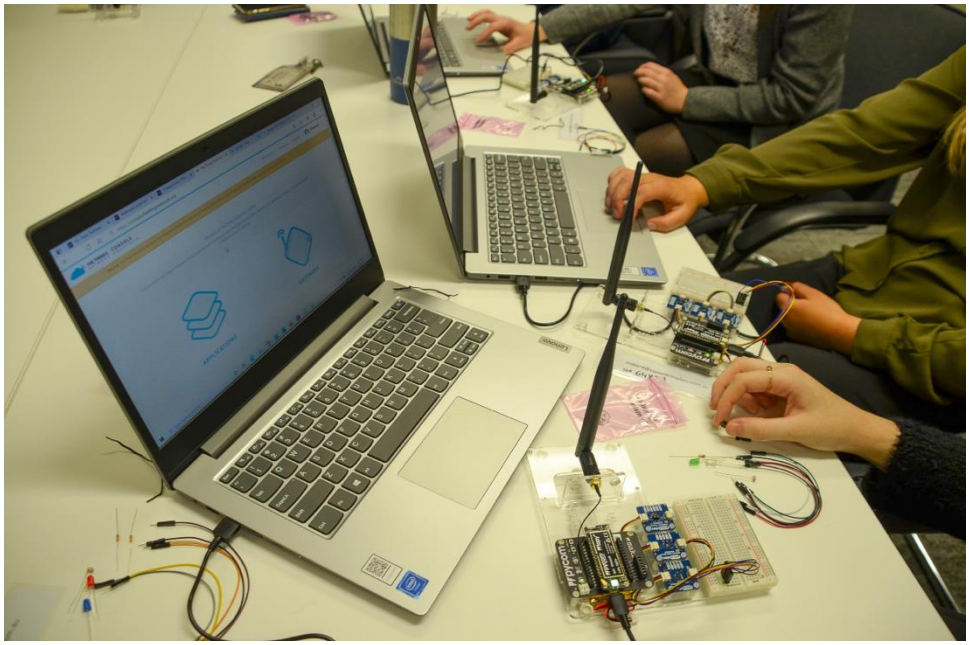
2. *Support data collection through DIY technology and digital literacy education*

Why?

- Citizen sensing projects can be created using build-it-yourself sensing devices that are easy to assemble, program, and activate.
- Improving the public's digital literacy develops community understanding of (and trust in) air quality data, which in turn supports a broader mandate for data-driven local government activities related to air quality.
- Giving community members the opportunity to engage with sensing technology in a hands-on way can help to put the public front and centre of your project, builds trust, and is often empowering for participants. This is especially important when engaging with marginalised communities for whom air quality is an environmental justice concern.

How?

- Be inspired by local government-run 'Fab Labs' and makers spaces which are becoming increasingly common worldwide; these are spaces in which to build a range of public programs around technology and data, and can double as semi-commercial resources to support local business innovation.
- Discover examples of successful school engagement programs that combine DIY air quality sensing devices, digital literacy, and citizen science activities; for example, the CleanAir Schools program in NSW and The Clean Air Outreach Project in Canada ((CleanAir Schools, n.d.; D'eon et al., 2021; Khalaf et al., 2023; Lake Macquarie City Council, n.d)



Construction of DIY air quality sensing device at the Lake Macquarie City Council IoT discovery workshops. Image source: Lake Macquarie City Council

3. *Encourage and support local open innovation on air quality*

Why?

- Sometimes, the most innovative uses for data can emerge from outside your organisation. If you make air quality data open and useable, educate people about its interpretation, and create spaces and events to nurture collaboration and creative engagement, you have the perfect recipe for encouraging local innovation on air quality.
- Innovative ideas and data applications may come from community members, students, or local businesses.

How?

- Make your data as open as possible, and publish it in accordance with FAIR data principles
- Consider making new or custom technologies (hardware or software) that you commission open-source, which encourages the wider community to get involved, and raises your organisation's profile as an innovation leader
- Curate events and programs with an air quality focus, such as hackathons, innovation festivals, design competitions, start-up challenges, or co-design workshops.

In 2019, Lake Macquarie City Council (NSW) commissioned a device that visualises live sensor data using LED lights to run data-activated public art pieces such as this sculpture in a skatepark. Image source: Lake Macquarie City Council

Activate public spaces

1. Support the creation of data-activated public art installations

Why?

- Real-time air quality data can be brought to life in public spaces through the creative use of installed elements, such as smart lighting, projection art, kinetic sculpture, and water features. This can make abstract, technical, or otherwise invisible information about air quality more visible, tangible, engaging, and a point of focus for the people who live or work nearby.
- Data-activated/informed installations or visualisations can also be powerful catalysts for local place activation.

How?

- Engage with your organisation's public art team about the possibility of funding new digital artworks that engage with themes linked to air quality
- Include data-activated art and/or local environment and community health themes in the public art agreement for new developments, requiring developers to help support the cost
- Run competitions for the public, students, or start-ups to prototype mobile or pop-up data-activated installations that can be displayed at events, or appear for short periods at local venues (such as libraries).

A public art piece at Melrose Park in Parramatta, NSW displays live air quality, heat, and weather data from a nearby sensing network. Image source: City of Parramatta

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Additional resources

MacroPlan* | *PLANNING FOR the urban freight evolution

This discussion paper aims to start a conversation with NSW planning authorities and stakeholders about the future of freight and logistics by highlighting the current situation and potential pathways forwards.

NSW Department of Planning and Environment* | *Interim Framework for Valuing Green Infrastructure and Public Spaces

This document provides guidance for those who are undertaking cost-benefit analysis of projects relating to public spaces and green infrastructure.

NSW EPA* | *Local government air quality toolkit

This toolkit provides local governments with information on air quality and how they can manage it. It includes details about the NSW regulatory framework that is in place for protecting air quality.

npj Climate and Atmospheric Science* | *Designing vegetation barriers for urban air pollution abatement: a practical review for appropriate plant species selection

A literature review that identifies how best to design vegetation barriers to maximise their impact on air pollution in urban environments.

Medical Journal of Australia* | *Bushfire smoke: urgent need for a national health protection strategy

This paper highlights some of the issues surrounding current health advice linked to bushfires, and the need for real-time air quality monitoring to minimise the public's exposure to bushfire smoke.

Medical Journal of Australia* | *Understanding and managing the health impacts of poor air quality from landscape fires

This paper (by a researcher at the Menzies Institute for Medical Research) highlights the health impacts of landscape fire smoke, and discusses mitigation strategies in Australia.

Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal Committee* | *Managing prolonged smoke events from landscape fires

This Australian Government guide provides nationally consistent recommendations to public health agencies for actions to be taken to protect human health during landscape fires. The advice is directed at various groups, including the general public, people who are likely to be vulnerable, and those in particular workplace settings (such as local governments).

National Centre for Epidemiology and Population Health | Australian National University College of Health and Medicine | How to protect yourself and others from bushfire smoke

Information on the health effects of bushfire smoke along with ten things that you and others can do stay safe when outdoor smoke levels are high.

Associated OPENAIR resources

Best Practice Guide chapter

Activities for impact

This Best Practice Guide chapter introduces a range of activities that can be undertaken by a local government to create impact relating to an air quality issue. Activities are categorised into four impact areas: transport; built environment; green infrastructure; and community engagement.

Further information

For more information about this project, please contact:

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This supplementary resource is part of a suite of resources designed to support local government action on air quality through the use of smart low-cost sensing technologies. It is the first Australian project of its kind. Visit www.openair.org.au for more information.

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