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Low-cost sensor networks

Interventions to improve awareness & reduce exposure to air pollution

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Sustainable Communities and Waste

National Environmental Science Program

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Project overview

Low-cost sensors

HEPA filters

Clean air centres

Impact example: Low-cost sensors

Problem: Lack of guidance

Low-cost sensors

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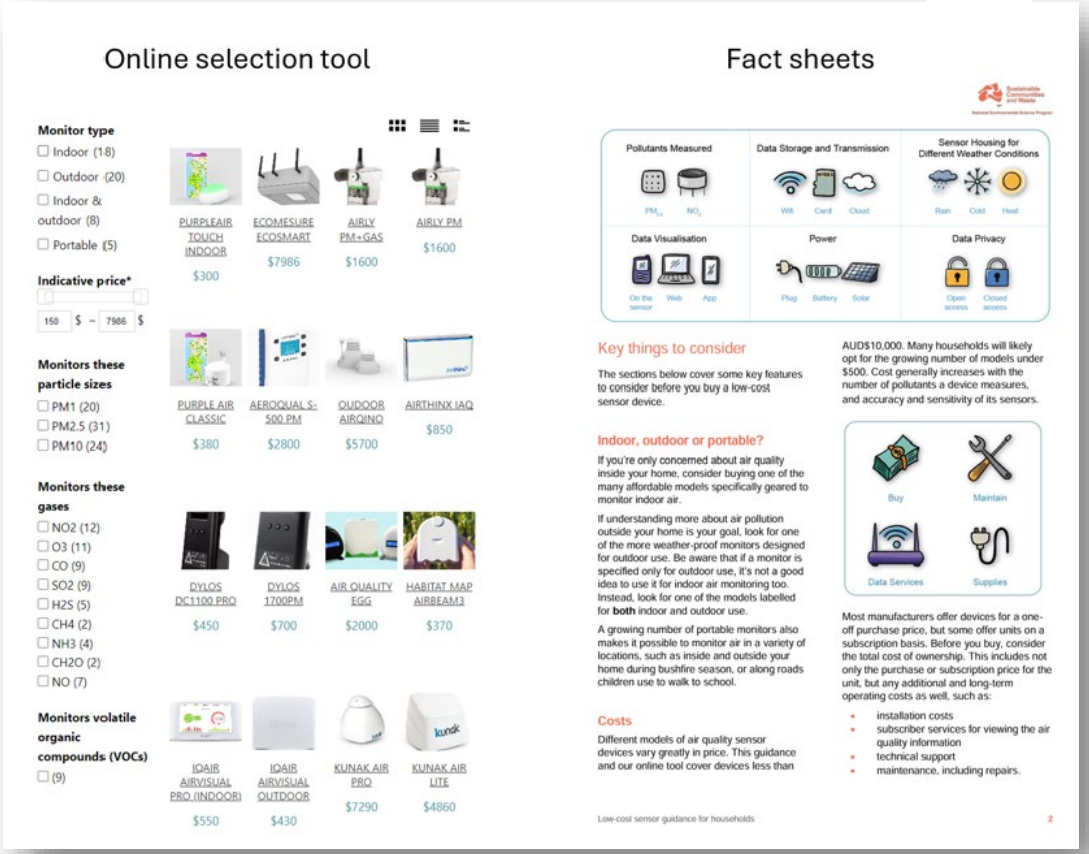
Impact example: Low-cost sensor

Solution: online guidance tool

Online selection tool



Fact sheets

IQAir AirVisual Pro (Indoor)

$550

Category: Indoor
Monitors these particle sizes: PM2.5
Data transmission: Wi-Fi
Data display: On-device display, app, web, API
Data storage: Local
Calibration: Factory calibrated
Size: 82 x 184 x 100mm
Power options: Plug-in, battery
Product page: https://www.iqair.com/au/air-quality-monitors
Sensor accuracy: PM2.5: 0.79 – 0.81

Guidance to select suitable monitors, building awareness of air pollution

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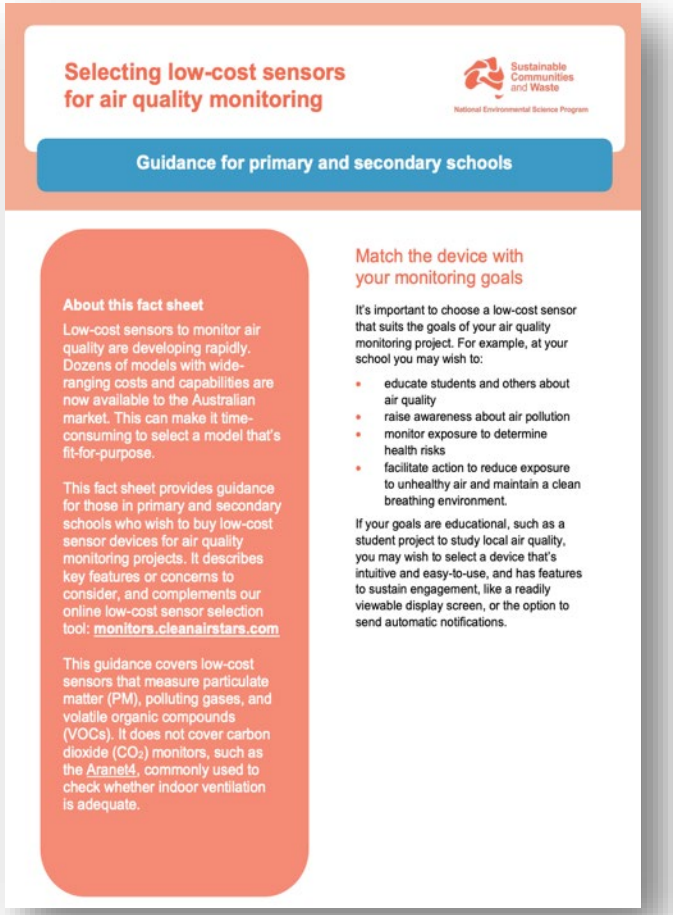
Impact example: Low-cost sensor

Solution: fact sheets for stakeholders



Selecting low-cost sensors for air quality monitoring

Sustainable Communities and Waste

National Environmental Science Program

Guidance for primary and secondary schools

About this fact sheet

Low-cost sensors to monitor air quality are developing rapidly. Dozens of models with wide-ranging costs and capabilities are now available to the Australian market. This can make it time-consuming to select a model that's fit-for-purpose.

This fact sheet provides guidance for those in primary and secondary schools who wish to buy low-cost sensor devices for air quality monitoring projects. It describes key features or concerns to consider, and complements our online low-cost sensor selection tool: monitors.cleanairstars.com

This guidance covers low-cost sensors that measure particulate matter (PM), polluting gases, and volatile organic compounds (VOCs). It does not cover carbon dioxide (CO_2) monitors, such as the Aranet4, commonly used to check whether indoor ventilation is adequate.

Match the device with your monitoring goals

It's important to choose a low-cost sensor that suits the goals of your air quality monitoring project. For example, at your school you may wish to:

- educate students and others about air quality
- raise awareness about air pollution
- monitor exposure to determine health risks
- facilitate action to reduce exposure to unhealthy air and maintain a clean breathing environment.

If your goals are educational, such as a student project to study local air quality, you may wish to select a device that's intuitive and easy-to-use, and has features to sustain engagement, like a readily viewable display screen, or the option to send automatic notifications.

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Pollutants Measured

$PM_{2.5}$ NO_2

Data Storage and Transmission

Wifi Card Cloud

Sensor Housing for Different Weather Conditions

Rain Cold Heat

Data Visualisation

On the sensor Web App

Power

Plug Battery Solar

Data Privacy

Open access Closed access

Key user concerns for selecting low-cost sensors

The following are some key things to consider when selecting a sensor model for your air quality monitoring project.

Indoor, outdoor or portable?

If your school's project is only concerned with indoor air quality, consider buying one of the many affordable models specifically geared for indoor monitoring.

If monitoring air pollution outside the school is your project's goal, look for one of the more weather-proof monitors designed for outdoor use. Be aware that if a monitor is specified solely for outdoor use, it's not a good idea to use it for indoor monitoring as well. Instead, look for one of the models labelled as suitable for **both** indoor and outdoor use.

A growing number of portable monitors also make it possible to monitor air in multiple locations. For example, students doing an air quality project could use these devices to explore air pollution sources inside and outside the school and along roadways.

Consider device costs & related expenses

Air quality sensor devices vary greatly in cost. This fact sheet and associated online tool define low-cost sensors as devices costing less than AUD$10,000. Device cost generally increases with the number of pollutants measured and the degree of sensor accuracy and sensitivity.

Buy Maintain

Data Services Supplies

Most models are available for a one-off purchase price, but some manufacturers offer units on a subscriber basis. 'Plug and play' models offer the option to easily replace individual sensors on the device, an attractive option for longer-term monitoring projects.

Impact example: Clean air centres

Problem: lack of data

Very poor	• STAY INDOORS as much as possible with windows and doors closed until outdoor air quality is better. • If you feel that the air in your home is uncomfortable, consider going to a place with cleaner air (such as an air-conditioned building like a library or shopping centre) if it is safe to do so. • Actively monitor symptoms and follow the treatment plan recommended by your doctor. • If you are concerned about symptoms call the 24-hour HealthDirect helpline on 1800 022 222 or see your doctor. • In a health emergency, call triple zero (000) for an ambulance.
Extremely poor	• STAY INDOORS with windows and doors closed until outdoor air quality is better and reduce indoor activity.

Clean air centres (i.e., shopping malls, libraries, community centres)

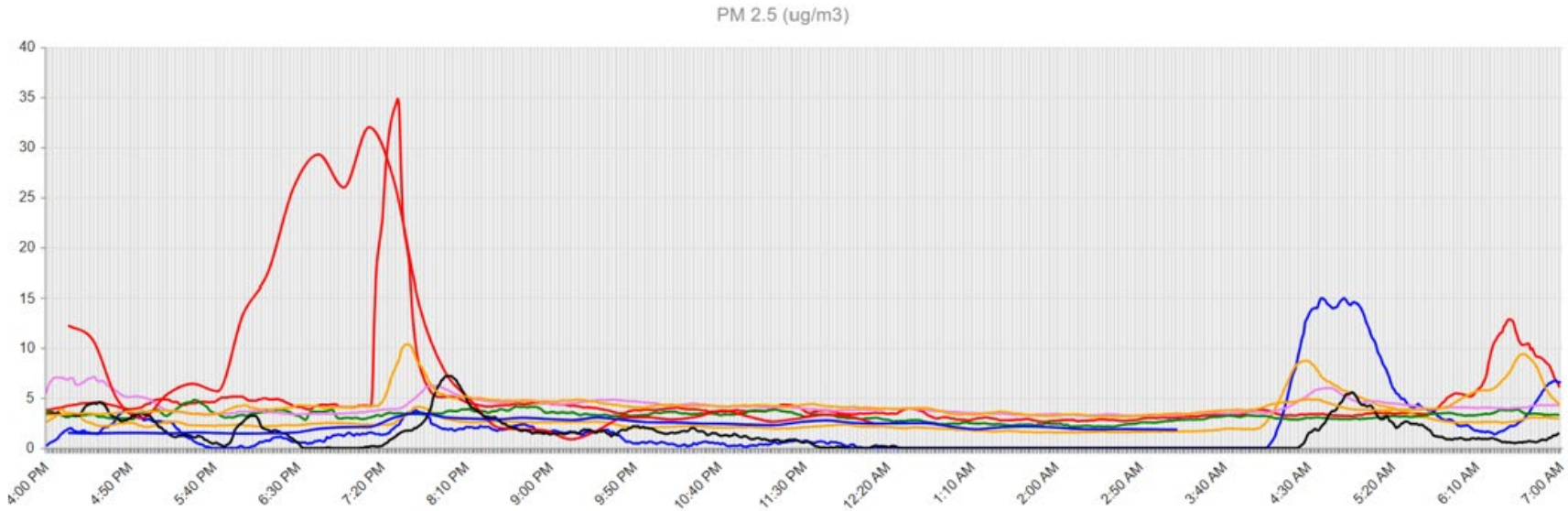
Impact example: Clean air centre

Solution: collect data, carry out filter intervention

Shopping centre air quality monitoring project

Impact example: Clean air centre

Solution: collect data, carry out filter intervention



Baseline indoor air quality data for major Sydney shopping centre

Impact example: HEPA guidance for classrooms

Problem: Lack of guidance on use of HEPA filters

Impact example: HEPA guidance for classrooms

Impact example: HEPA guidance for classrooms

Home - What is HEPA?

HEPA & healthy classroom air FAQ

Air pollution is today's greatest environmental health risk. Good air quality supports children's healthy development and contributes to staff wellbeing.

Explore the topics below for answers to frequently asked questions about HEPA air filters and natural ventilation. Learn why indoor healthy air is so important, and what air quality monitors can tell us.

This FAQ is for schools or other buildings with **natural ventilation** or **hybrid** (natural combined with mechanical ventilation) systems. It's **not** for schools that use only mechanical ventilation or have HVAC systems.

HEPA filters & how to use them

Find practical information on how how to buy, use and maintain HEPA filters to clean indoor air.

What are HEPA units?

The air filtering appliances commonly called HEPA (High Efficiency Particulate Air) filters or HEPA units look like large rounded or square boxes with lots of small holes on their sides. Inside a typical unit you'll find a motor and a fan that draws air through a pre-filter, and behind that, the HEPA filter itself.

Each HEPA filter consists of a mat of dense fibres, arranged in pleats to increase its surface area. Air and any pollutants it contains is drawn through the filter, which traps pollution particles across a wide range of sizes. The unit vents clean air back into the room and the pollutants stay trapped inside the filter.

HEPA filters need to be replaced when they fill with dirt and dust.

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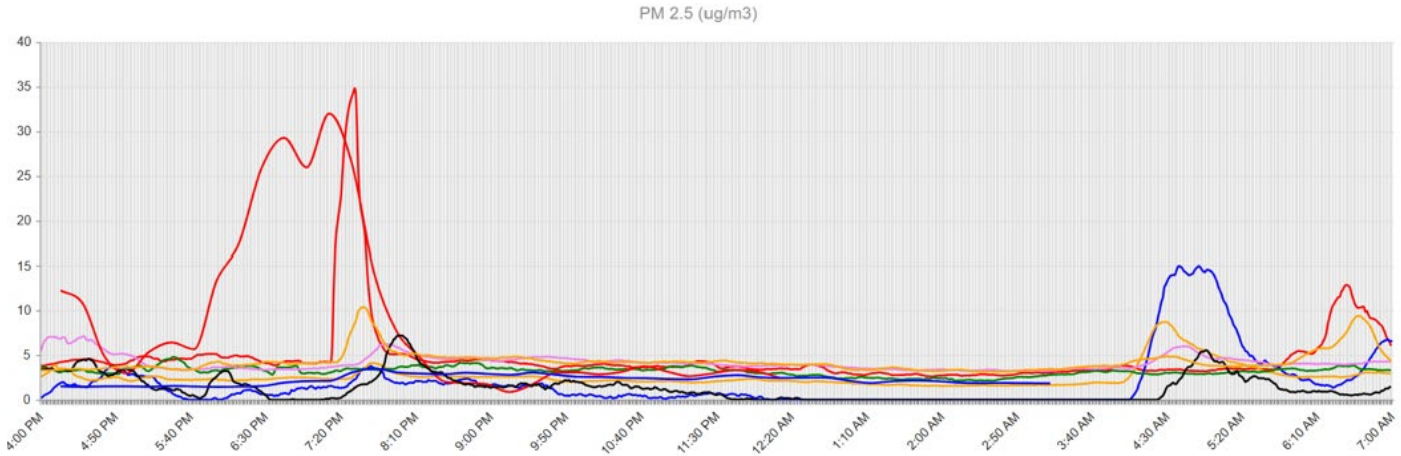
What's next



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What's next

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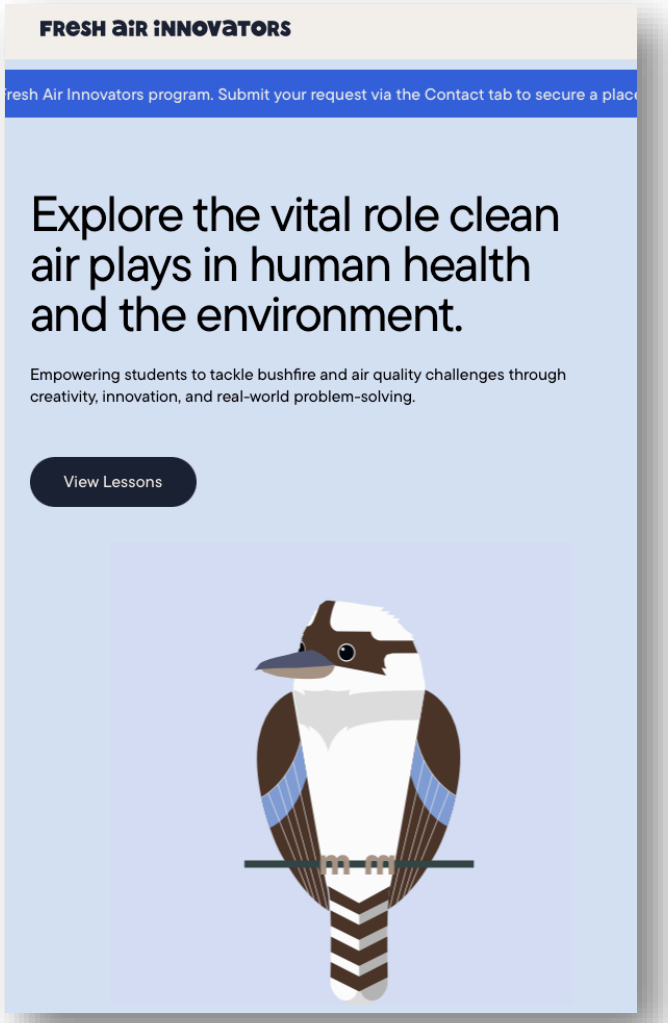
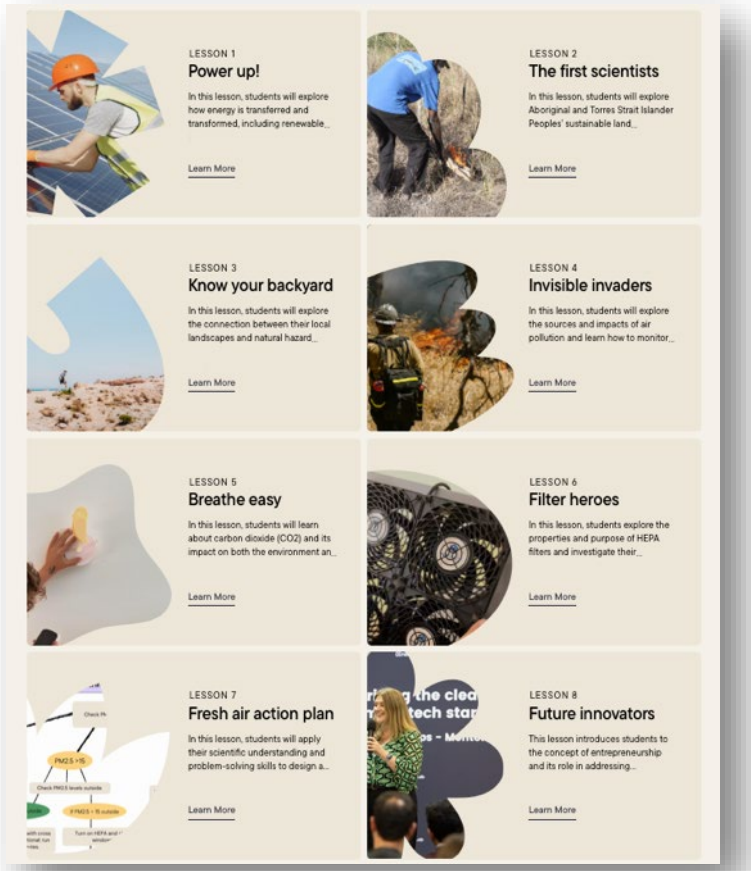
What's next





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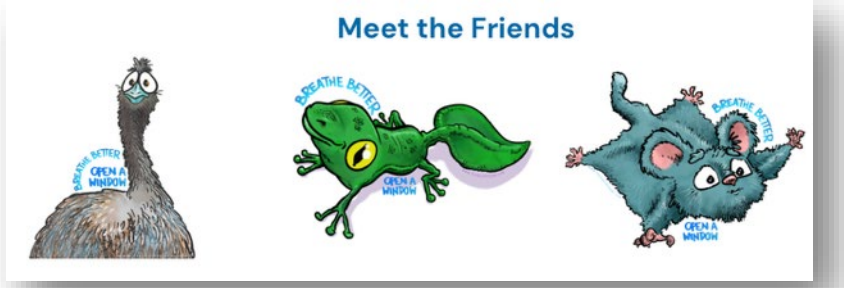

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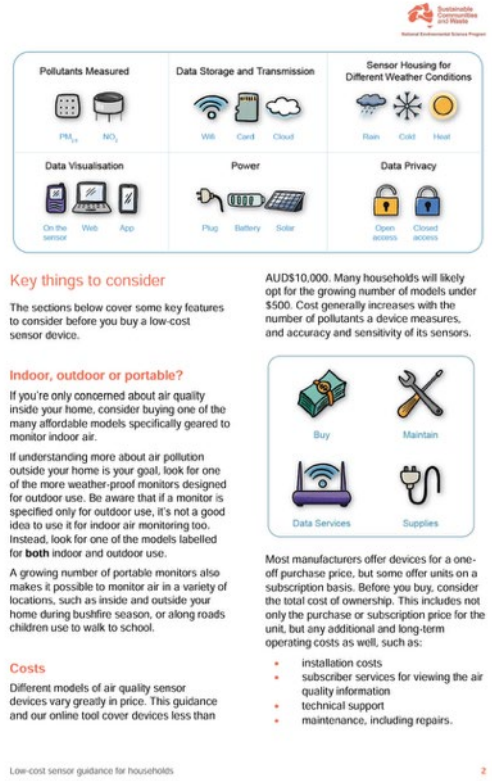
Impact of EMCRs on project

Nathan Cooper

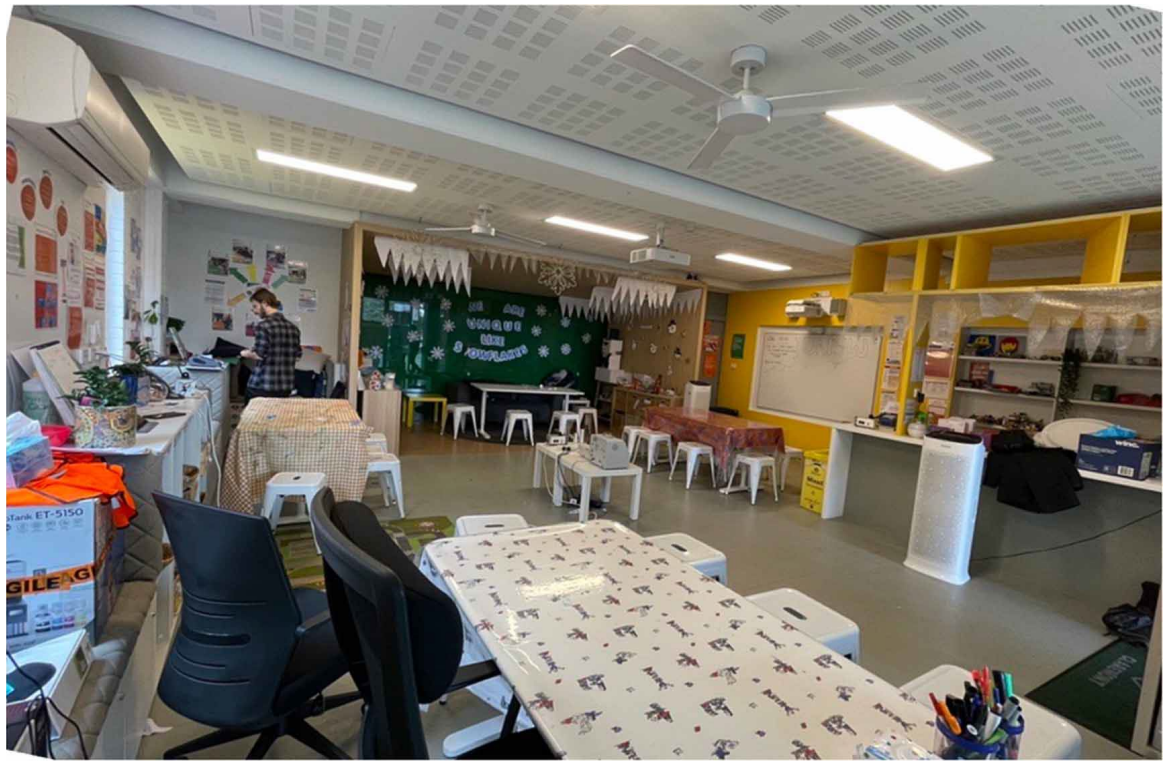
Air quality, data analysis, environmental health & environmental justice

Janice Wormworth

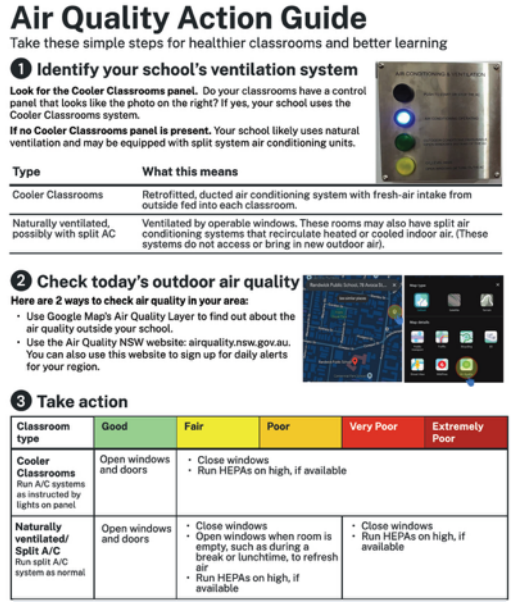
Environmental policy, digital content & communications



Impact example: Classroom study



Controlled study of interventions to optimise air quality using a real-world classroom setting with volunteers.



Air Quality Action Guide

Take these simple steps for healthier classrooms and better learning

1 Identify your school's ventilation system

Look for the Cooler Classrooms panel. Do your classrooms have a control panel that looks like the photo on the right? If yes, your school uses the Cooler Classrooms system.

If no Cooler Classrooms panel is present. Your school likely uses natural ventilation and may be equipped with split system air conditioning units.

Type	What this means
Cooler Classrooms	Retrofitted, ducted air conditioning system with fresh-air intake from outside fed into each classroom.
Naturally ventilated, possibly with split AC	Ventilated by operable windows. These rooms may also have split air conditioning systems that recirculate heated or cooled indoor air. (These systems do not access or bring in new outdoor air).

2 Check today's outdoor air quality

Here are 2 ways to check air quality in your area:

- Use Google Map's Air Quality Layer to find out about the air quality outside your school.
- Use the Air Quality NSW website: airquality.nsw.gov.au. You can also use this website to sign up for daily alerts for your region.

3 Take action

Classroom type	Good	Fair	Poor	Very Poor	Extremely Poor
Cooler Classrooms Run A/C systems as instructed by lights on panel	Open windows and doors	• Close windows • Run HEPAs on high, if available			
Naturally ventilated/ Split A/C Run split A/C system as normal	Open windows and doors	• Close windows • Open windows when room is empty, such as during a break or lunchtime, to refresh air • Run HEPAs on high, if available		• Close windows • Run HEPAs on high, if available	

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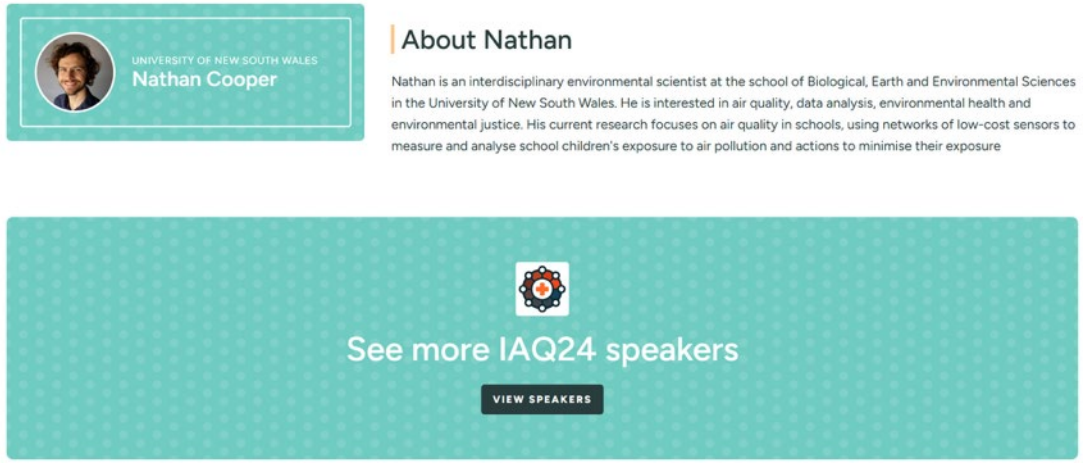
EMCR career impact

Wider benefits due to this research:

- Enhanced expertise in air quality monitoring using LCS
- Deeper understanding of data analysis for air quality studies
- Expanded research networks through national and international presentations



Example: In 2024 I gave a presentation about our clean air centres project at Australia's main conference for HVAC&R industry stakeholders.

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Q&A

Questions?

Web links:

Low-cost sensor guidance: monitors.cleanairstars.com

HEPA guidance: cleanairschools.com.au/what-is-hepa

Fresh Air Innovators: freshairinnovators.com.au

Fresh Air Friends (stickers): freshairfriends.com