

Trial of a sensor-driven dashboard to empower and train schoolchildren to manage classroom air quality

Dr Ian Longley

Director, The Air Quality Collective





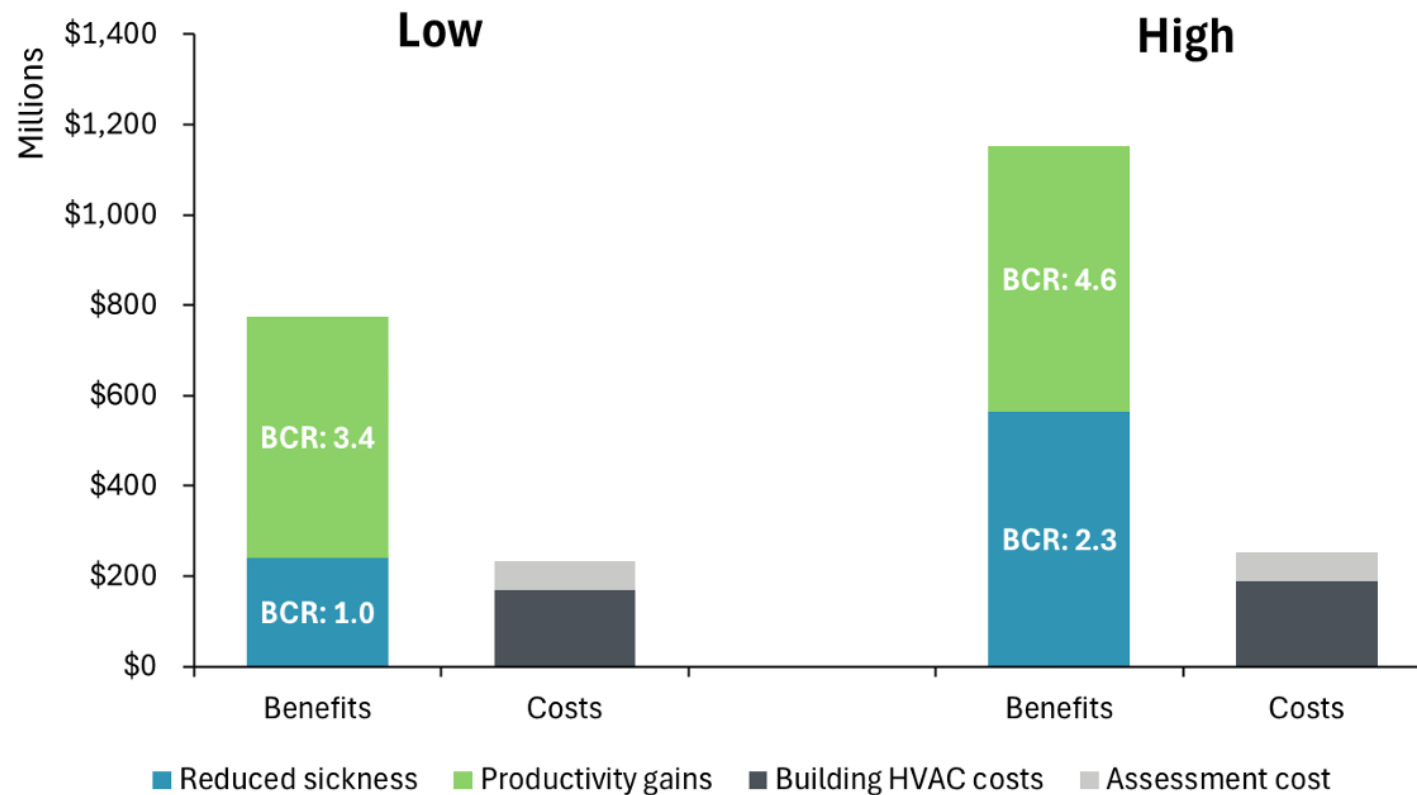
Time to clear the air

The economic benefits of improving New Zealand's indoor air quality

17 September 2024



FIGURE 1: IMPROVING IAQ IN OFFICES, NET PRESENT VALUE OVER 10 YEARS



Source: Sense Partners



Air filtration systems didn't reduce the risk of COVID-19



John Elder

Nov 26, 2023, updated Nov 28, 2023

SHARE



For more reliable ventilation it may be best to open a couple of windows. *Photo: Getty*

In 2021, the Victorian government spent more than \$113 million on air purifiers for school classrooms. The purifiers were meant to help prevent the spread of COVID-19 among children and teachers.

There was no data to suggest they worked beyond providing some psychological comfort.







Te Tāhuhu o
te Mātauranga
Ministry of Education

COVID-19 RESPONSE

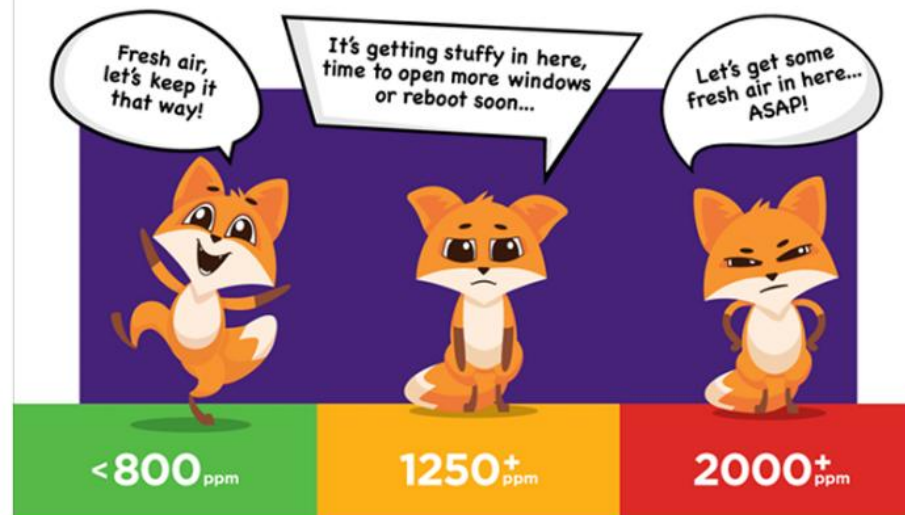
Ventilation Guidance for New Zealand Schools

PUBLISHED MARCH 2023



Help Slow COVID-19

and other illnesses using the power of fresh air. If CO₂ levels stay high for an hour or more, follow these tips to refresh the air:



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Saturday, 4 June 2022

Ventilation rules fail to account for frosty Central

By Wyatt Ryder

[Regions](#) > [Central Otago](#)

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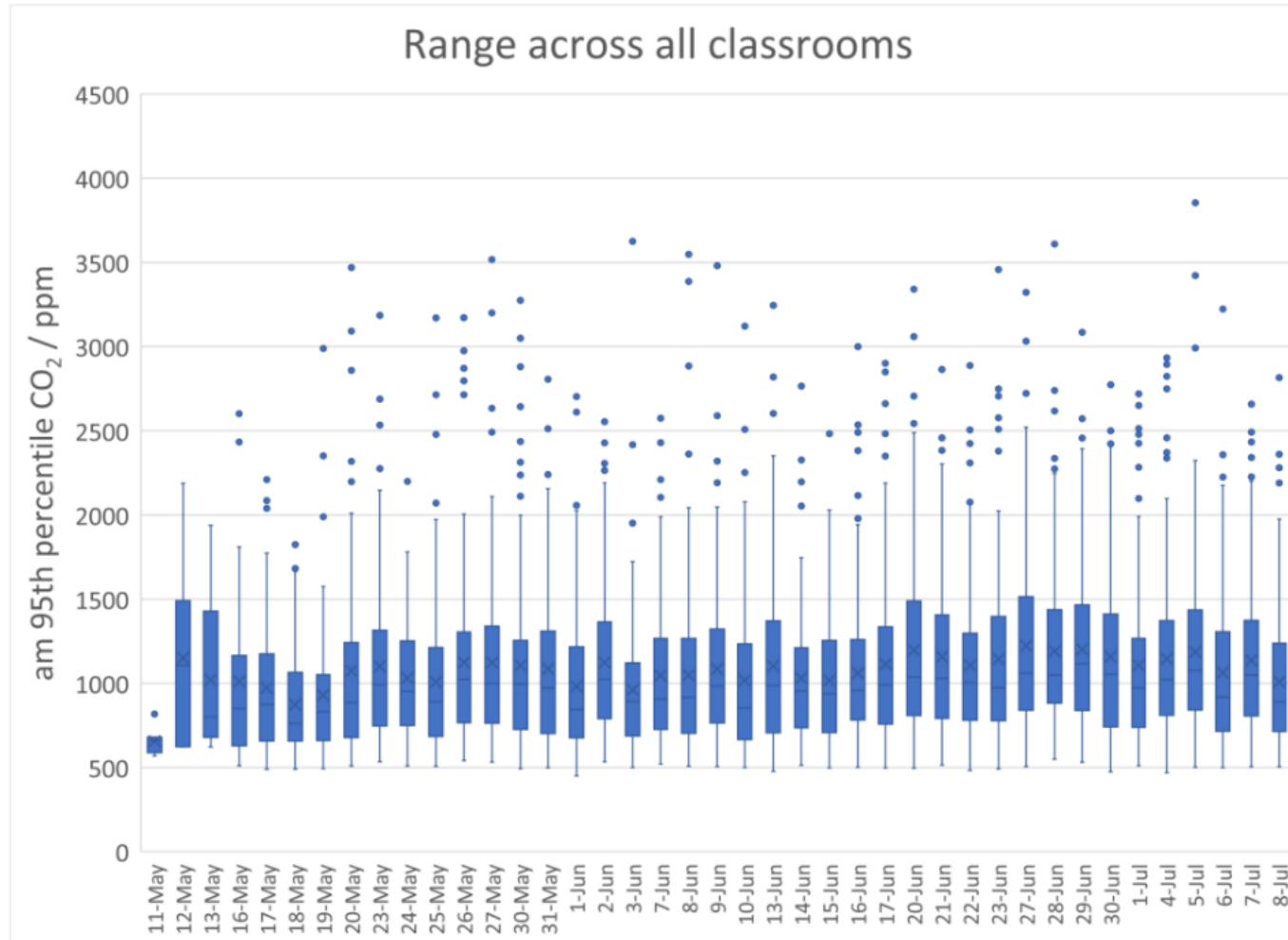
Hollywood A-lister Taika Waititi enjoys Dunedin's bars

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No clear impact of guidance on classroom CO₂





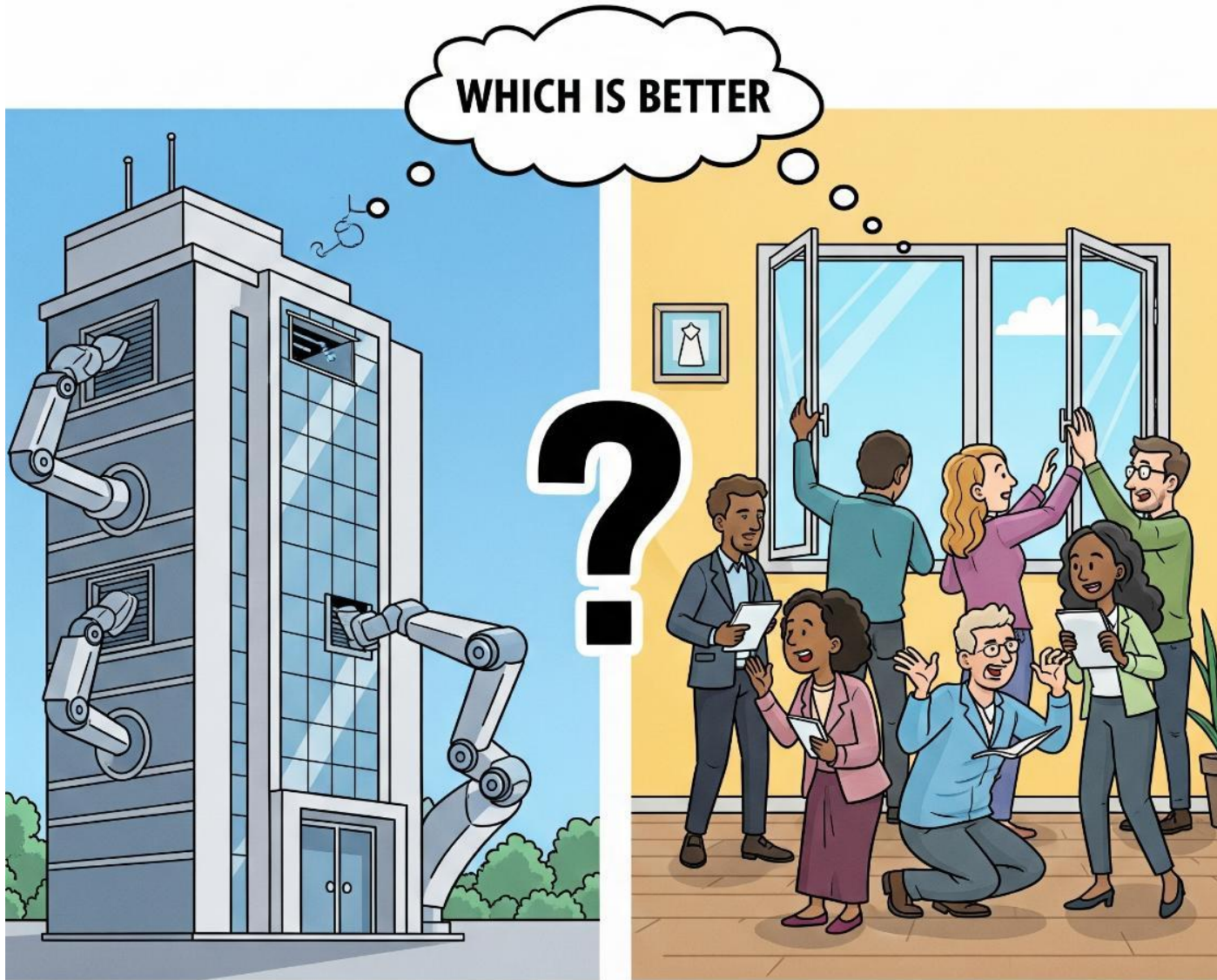
Filtration

- Generates noise
- Consumes power
- Benefits invisible to users
- (No impact on CO₂)



Monitoring

- Engagement left to chance
- Links to action left to chance



**AUTOMATED
VENTILATION**

**MANUAL VENTILATION
(EDUCATION)**

LOOK AT THIS FROM A TEACHER'S PERSPECTIVE

We learn by doing

We learn from feedback (trial-and-error)

We learn from reflecting on our experience

We learn through creative pathways as much as intellectual

We build confidence in our agency from taking rewarding excursions outside our comfort zone

We consolidate learning by teaching others



Diagnose



Act



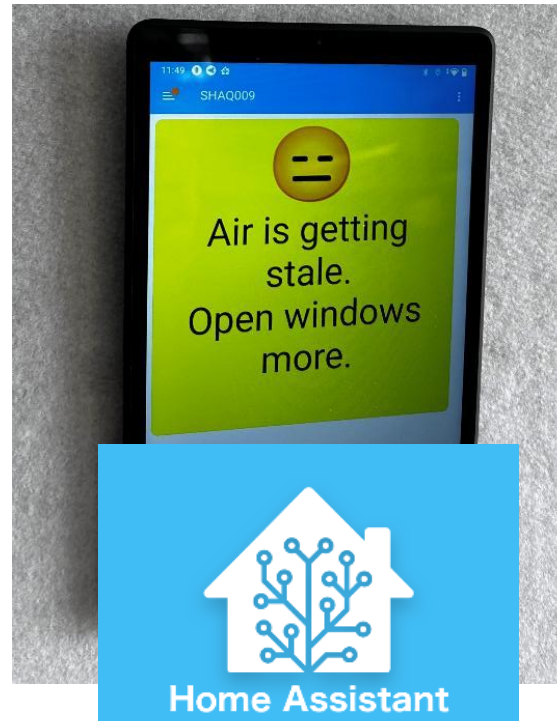
Evaluate



The Smart Air Quality System

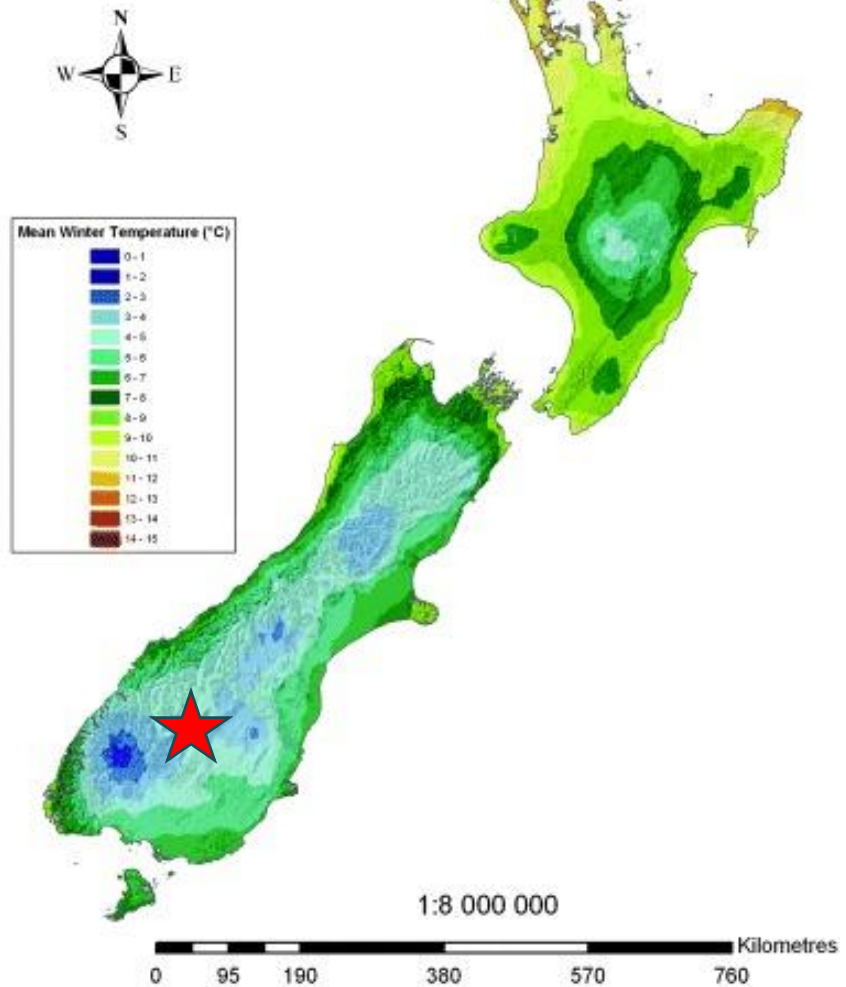


Qingping Lite:
PM, CO₂, T, RH



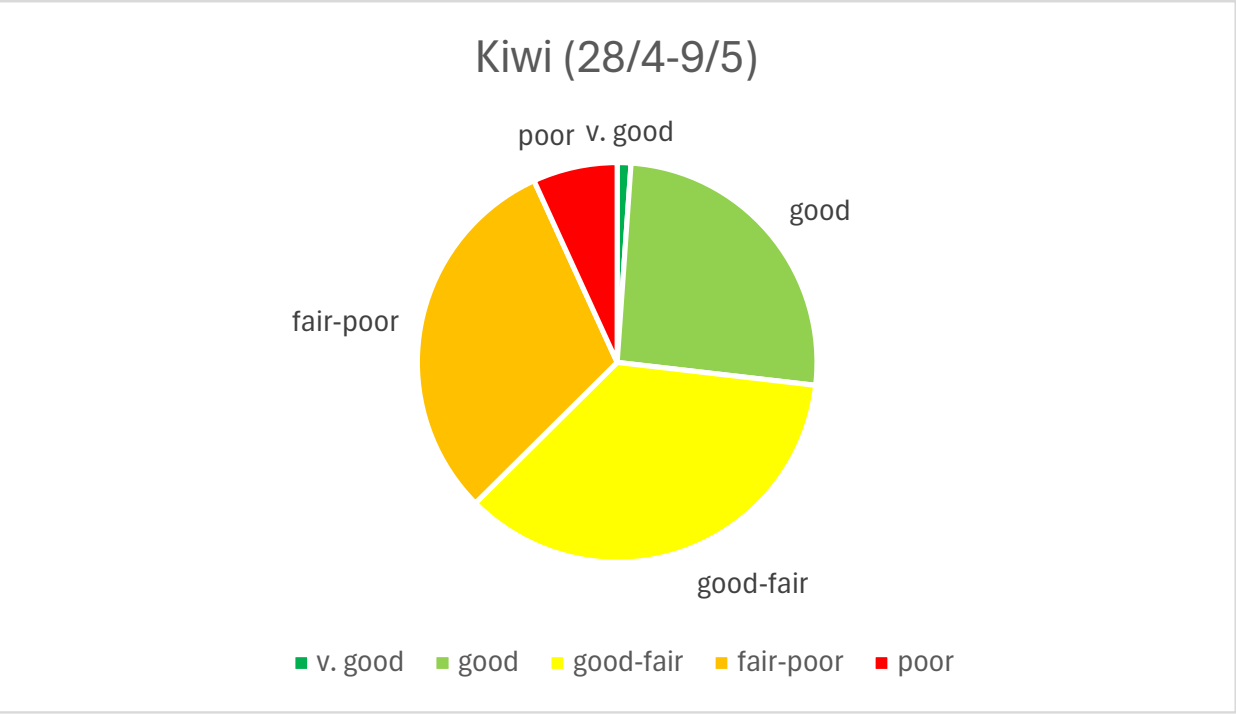
“Mila” HEPA portable air cleaner

Mean Winter
Temperature
for New Zealand



Methods

Phase 0: Baseline measurements



	PPM level	Actions to consider
	Under 800	Your space is well ventilated for its current activity, continue with the current approach.
	800 to 1,250	Open windows more if this can be done without raising temperatures. Consider lowering the level of activity, regularly purging and refreshing the air.
	1,250 to 2,000	Take further action to introduce more fresh air. » Open all windows and doors as much as possible so while maintaining comfortable indoor temperatures. » Reboot the room by fully opening all windows and doors (for 15 minutes), preferably while vacating the room. » Reduce the level of vigorous activity people are undertaking. » Consider utilising other protective measures such as physical distancing.
	Over 2,000	If you have followed the above advice and CO ₂ levels are still over 2,000ppm for a sustained period of time, consider very frequent CO ₂ peak levels exceeding 2,000ppm as a property advisor. In addition, instigate at least four reboots per week: reboot the room with all windows and doors open for 15 minutes with the room unoccupied.

Figure 2.1 CO₂ levels and associated actions to take to improve ventilation

Phase 1: Using banded CO₂ data to drive ventilation behaviour

Air Quality
FAIR

If your air is green...

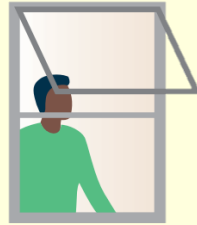


...sweet as!

If your air goes yellow...



...open a window or door

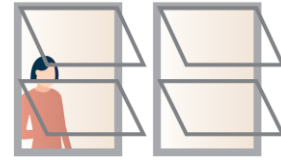


If your air goes red...



...open some more

Some other ways to get into the green...



Open more windows



Limit the number of people



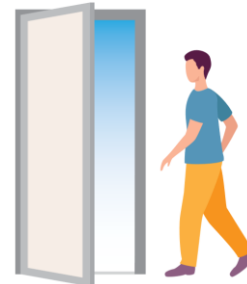
Open windows more widely



Move to a bigger or better ventilated room



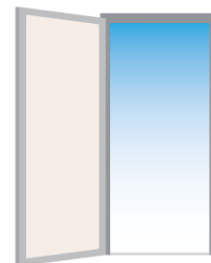
Open windows or doors on opposite sides of the room



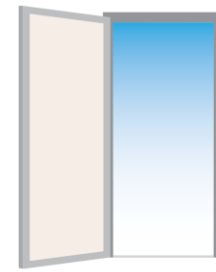
Open an external door



Open an internal door to a larger or better – ventilated room



Open an external door more



Use a pedestal fan near an open door or window



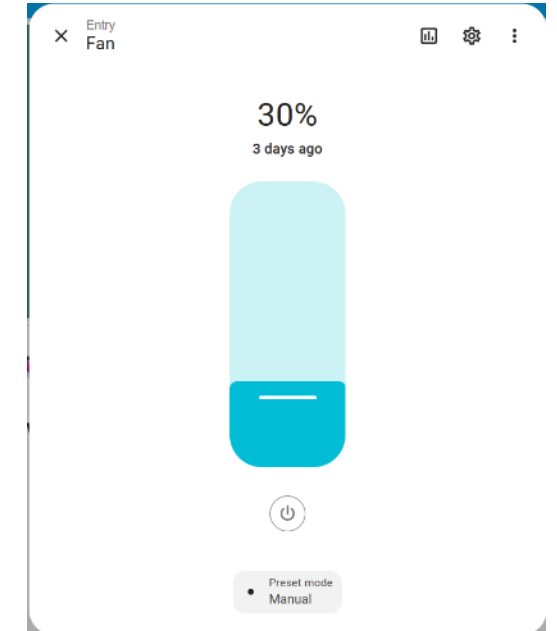
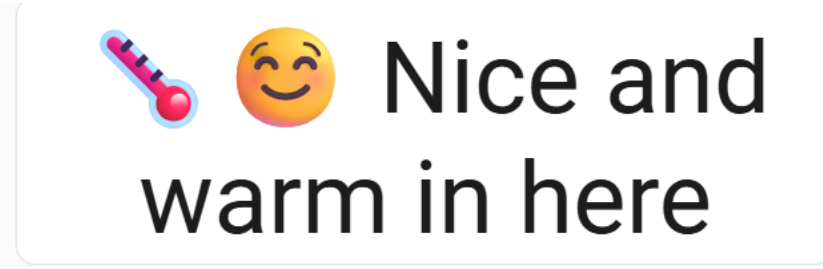
Phase 2: Using banded CO₂ and temperature data to balance ventilation

Air Quality
FAIR



Nice and
warm in here

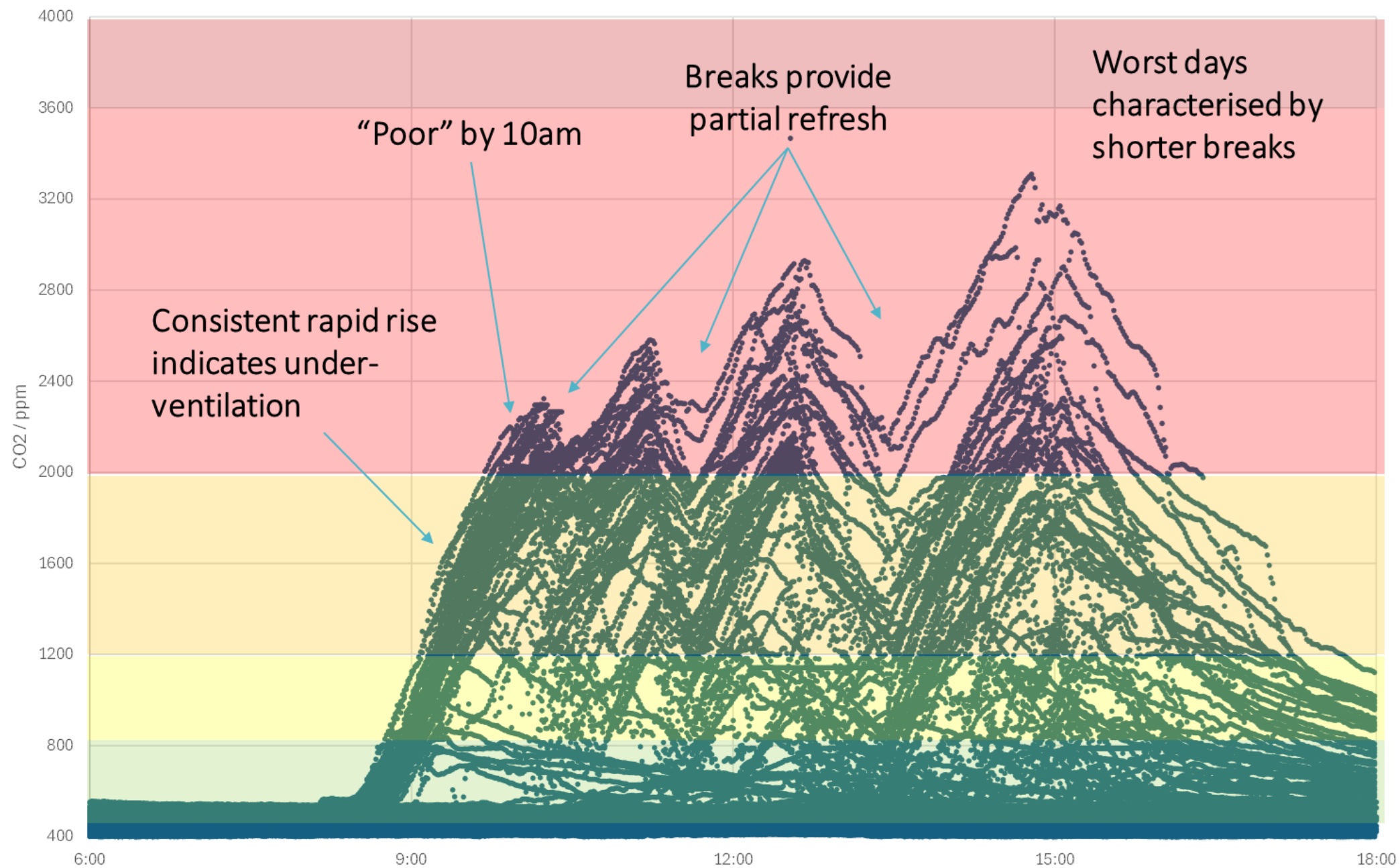
Phase 3: Adding a multi-factor “infection risk” index to balance ventilation and filtration

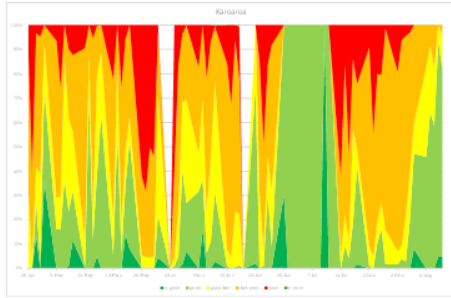


Karearea room -
the control

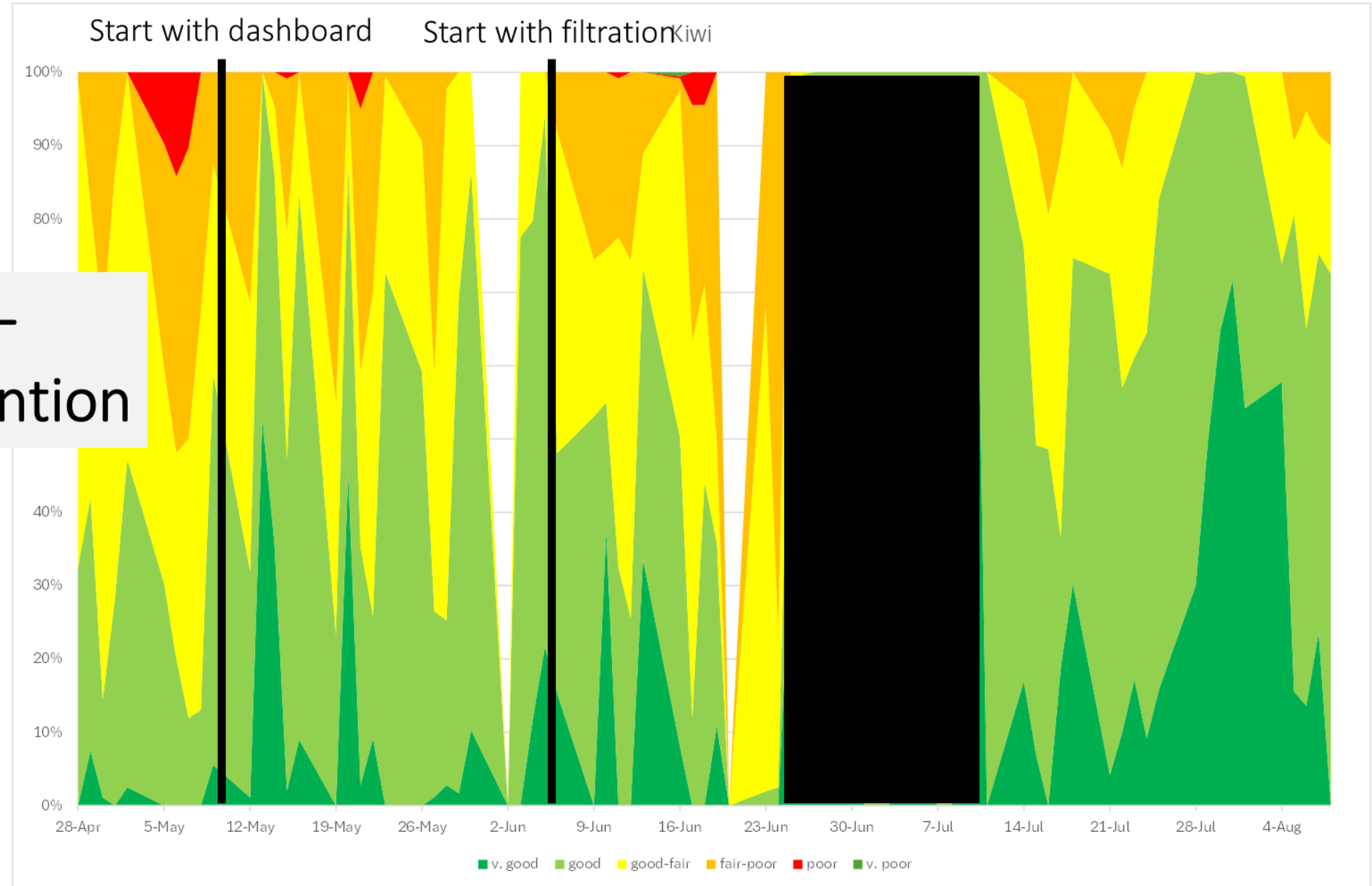


Karearea

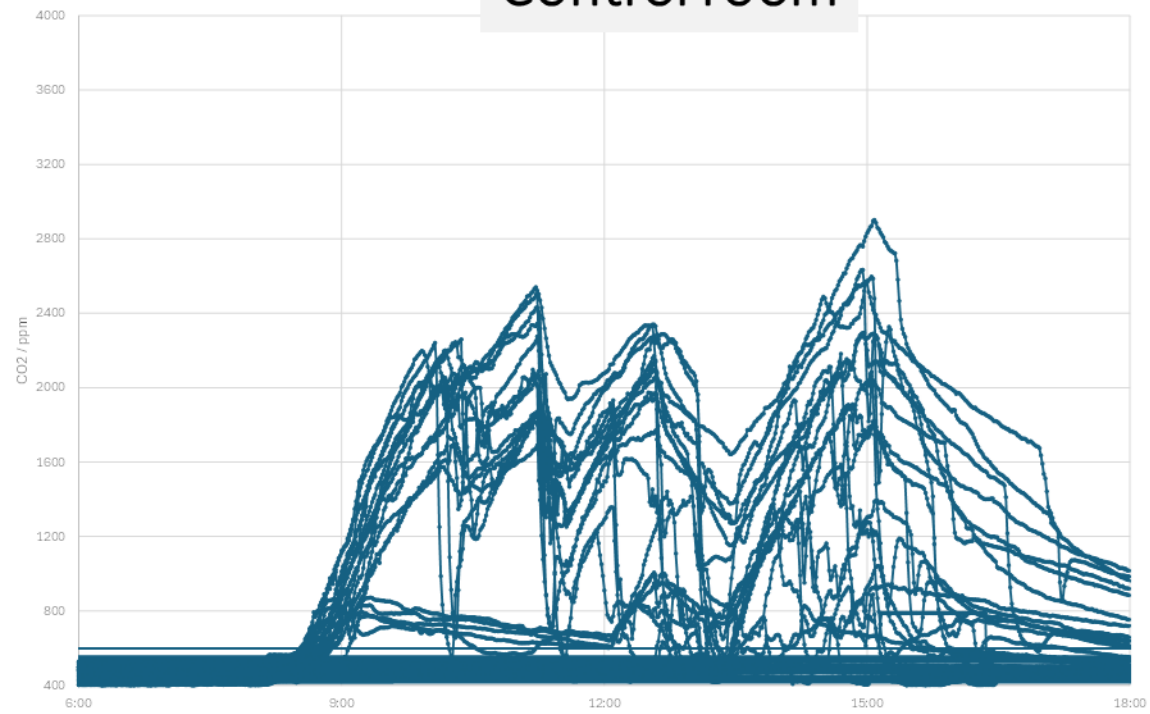




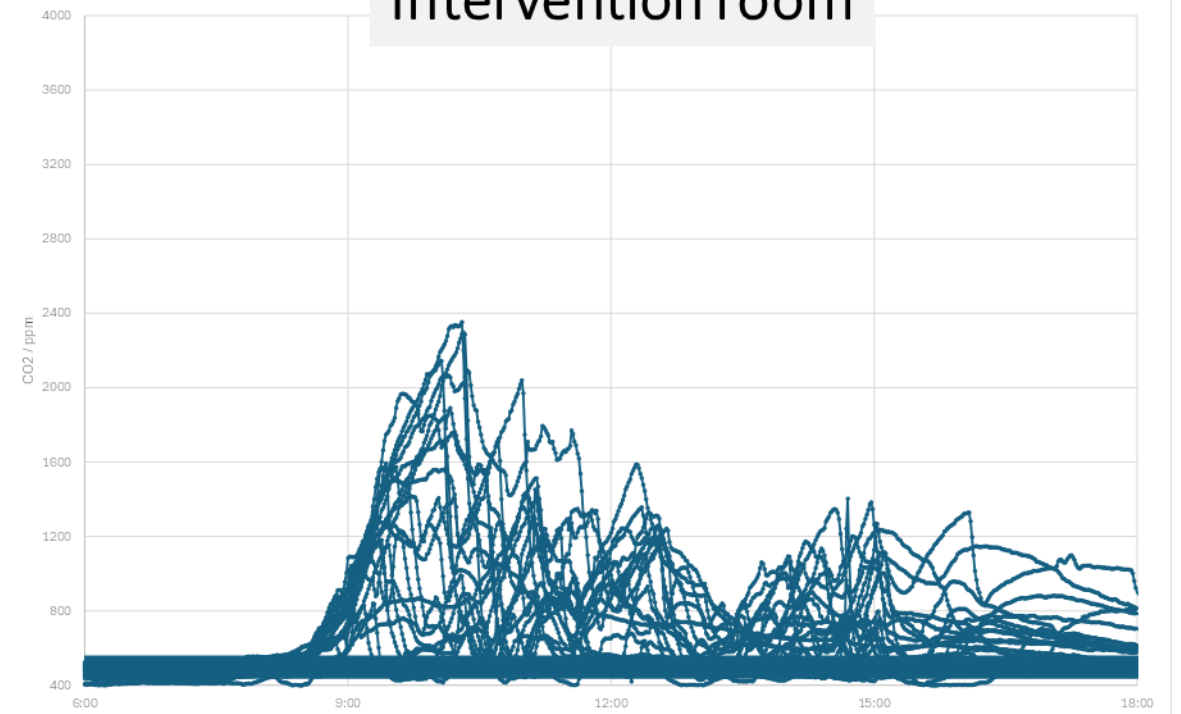
Kiwi room – the intervention



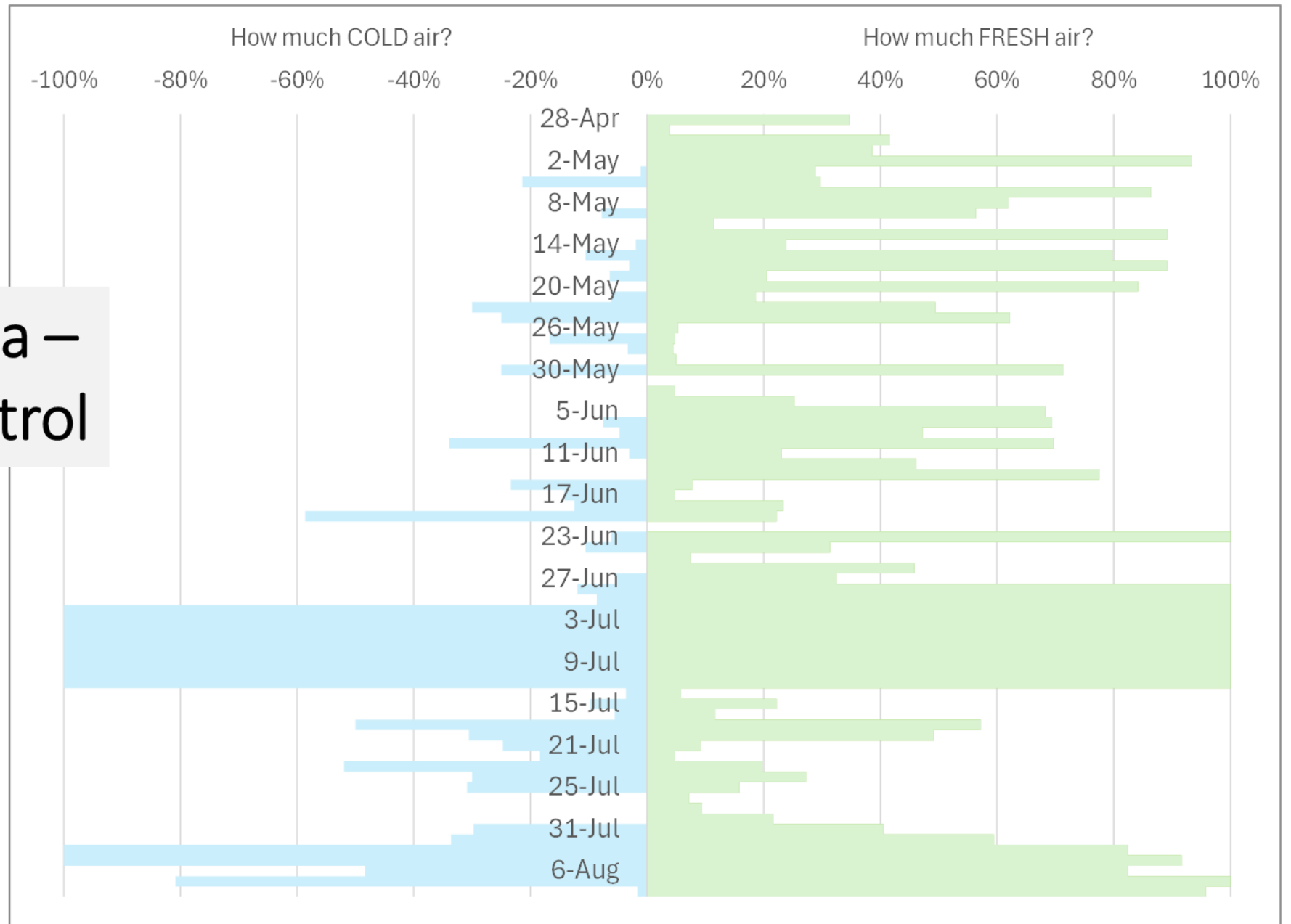
Control room



Intervention room



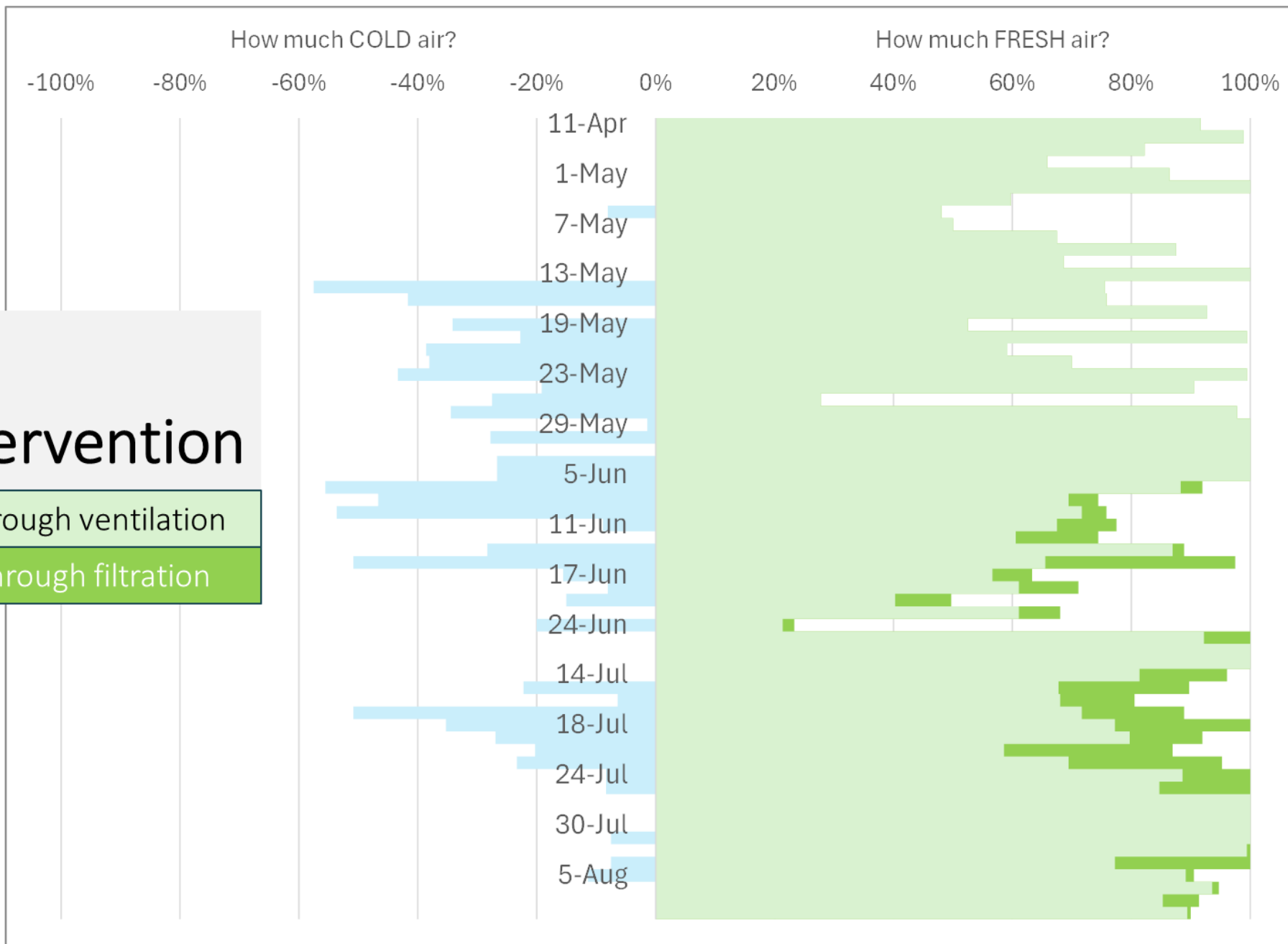
Karearea –
the control

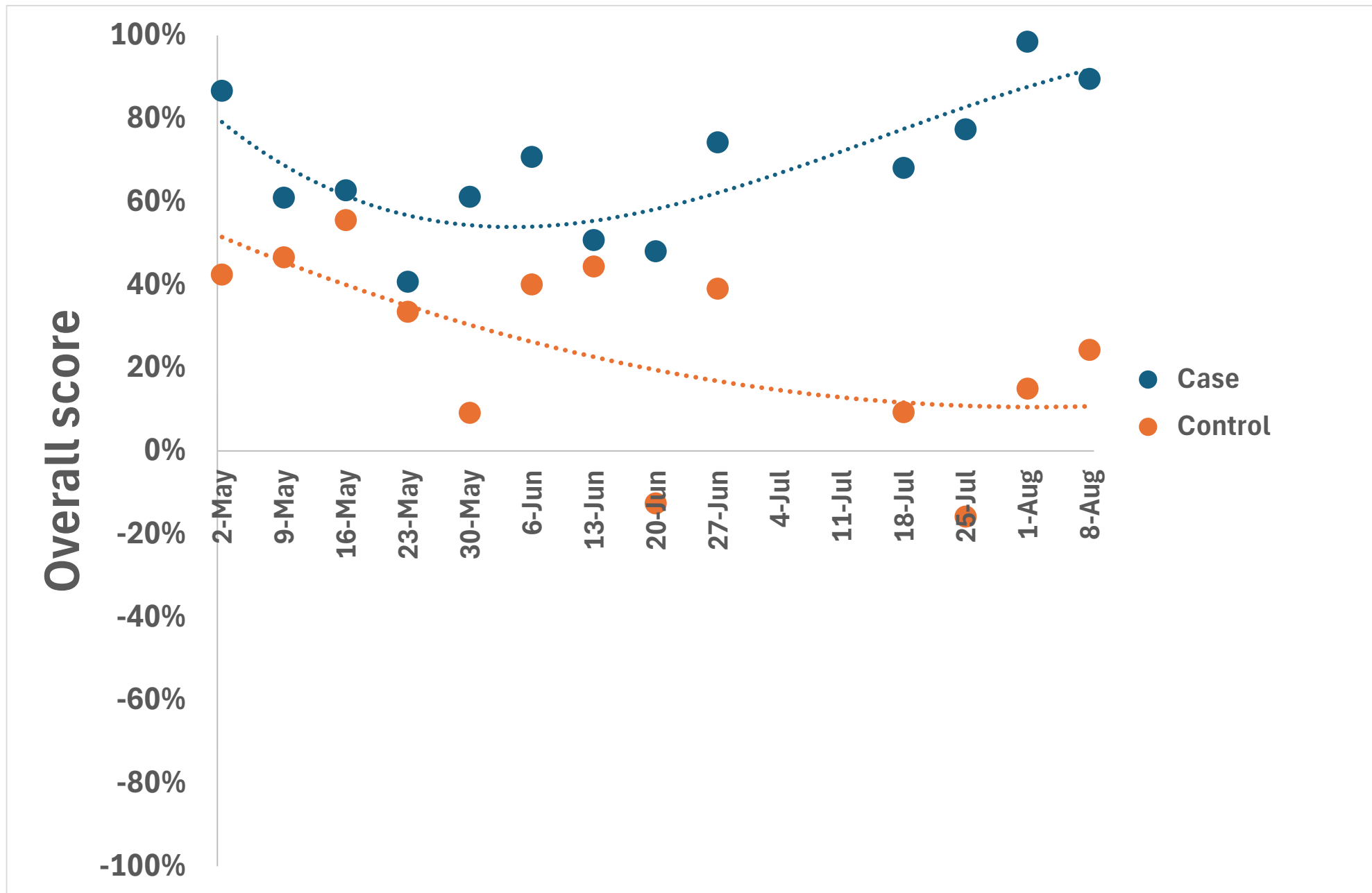


Kiwi – the intervention

Achieved through ventilation

Achieved through filtration





10°	22.4	994	5	5	quite good
11°	20.6	594	3	3	Good

Temp outside	Temp inside	CO ₂ level	PM2.5	PM10	Tablet air quality	Notes
1c	17.0	1225	10	10	Fair	little cool
2 1c	21.2	1719	11	11	Fair	nice and warm in here
2	19.6	925	12	134	quite good	nice and warm in

12:00	in	0	none	1 window 1 door	24
1:00	out	0	none	1 window 1 door	2
2:00	in	0	none	1 window 1 door	11
3:00	out	0	none	1 window 2 doors	1

SOPHIA ~ Karisma

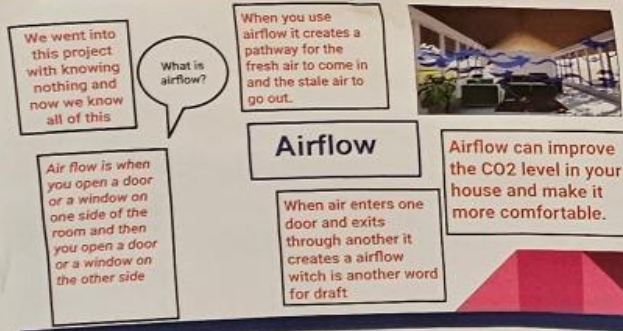
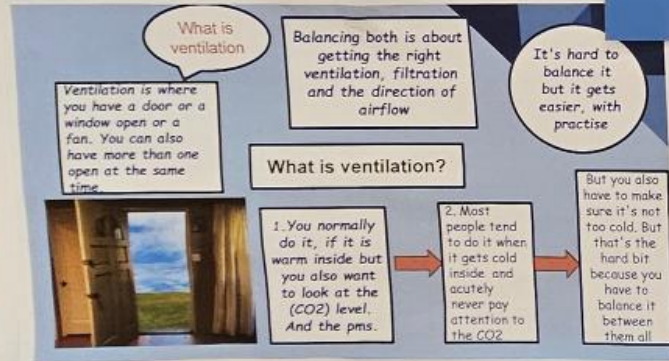
Date	Time	In or out of class	Filtration level	Filtration noise level	Ventilation	Number of people in class
13 th August						
	9:00	IN	39	ok	X	28
	10:00	IN	12	ok	X	29

What is the best combination of ventilation, filtration, advice and automation for our classroom?

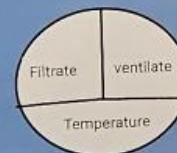
6. Balancing both (Ventilation and Filtration)

Martha, Jack & Shelby

How to
Ventilate, filtrate and diagram of airflow
It is all about balance

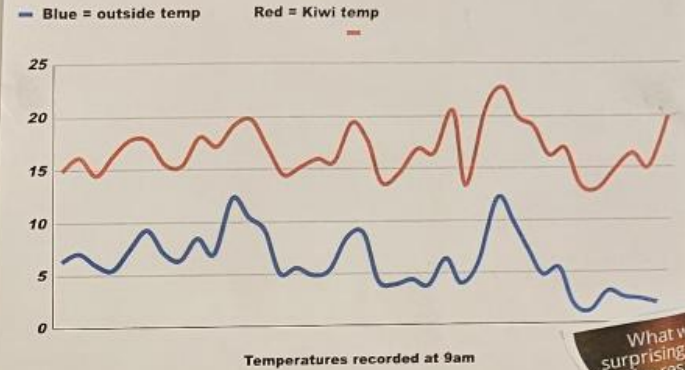


Hope you enjoyed learning about
Maintaining the warmth, ventilation and filtration

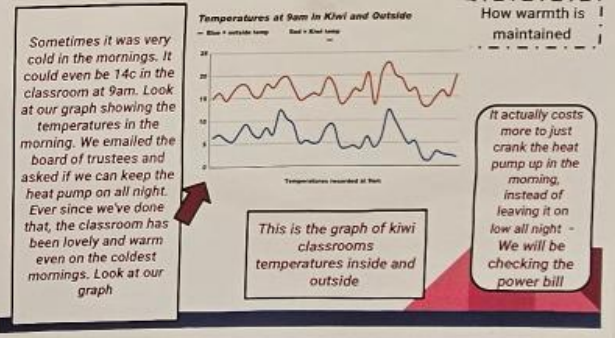


See it's all about
BALANCE

Temperatures at 9am in Kiwi and Outside



The data showed us that it was too cold for learning in the morning even though the heap pump was on since 7am





lets check

bad air



$$9 \times 2 = 12$$

$$9 \times 4 = 35$$

$$9 \times 5 = 41$$

$$9 \times 10 = 910$$

$$9 \times 6 = 96$$

$$9 \times 7 = 97$$



this is
pms in
the air

When classrooms are at a good temperature, fresh air and good CO₂ levels, students did much better on cognitive tests. However, when CO₂ levels were high or the temperature was too hot or too cold, students didn't do as well.







How we improved air quality



NEXT STEPS

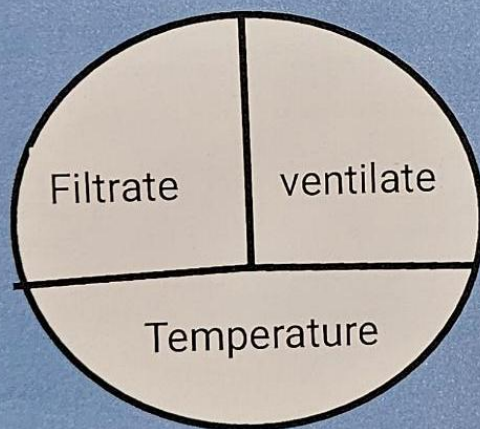
- Does learning persist?
- Can the dashboard be optimised for action?
- How can the process be best integrated into school life?
- Where else can this approach be used?

balance it
between
them all



can improve
level in your
and make it
comfortable.

Hope you enjoyed learning about
Maintaining the warmth, ventilation and filtration



See it's all about
BALANCE

Sometimes it was very cold in the mornings. It could even be 14c in the classroom at 9am. Look at our graph showing the temperatures in the morning. We emailed the board of trustees and asked if we can keep the heat pump on all night. Ever since we've done that, the classroom has been lovely and warm even on the coldest mornings. Look at our graph

Temperat

Blue = outside



Acknowledgements

We acknowledge the kind and enthusiastic participation of
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