Appendix Three – Table of contents

Document 1: Discussion between VTAG members and Programme team regarding CO2 guidelines for schools

From: Scott MacKenzie
To: mark.jermy; Robyn Phipps; Ian Longley; Ackley Aniebietabasi
Subject: RE: some thoughts on CO2 guidelines for schools
Date: Wednesday, 7 December 2022 12:32:39 pm
Attachments: image002.png
image003.png

Got it – my view is make it a behind the scenes setting we can change, and we think about 'good, carry on' being under 800pm, over 1000pm being 'get more' and in between being 'good but heading towards not so'. That way we are true to the widely discussed 800ppm, and also the 1000pm MoE standard.

Scott MacKenzie
Programme Director, Ventilation
Mobile 9(2)(a)

From: Mark Jermy <mark.jermy@canterbury.ac.nz>
Sent: Wednesday, 22 December 2021 9:57 am
To: Scott MacKenzie <Scott.MacKenzie@education.govt.nz>; Robyn Phipps <robyn.phipps@vuw.ac.nz>; Ian Longley <Ian.Longley@niwa.co.nz>; Ackley Aniebietabasi <Ackley.Aniebietabasi@education.govt.nz>
Subject: RE: some thoughts on CO2 guidelines for schools

Hi Scott,
This was about the ventilation self assessment tool, and what CO2 level we change the advice from "good, carry on what you're doing" to "OK not too bad but get more ventilation".
Cheers,
Mark

From: Scott MacKenzie <Scott.MacKenzie@education.govt.nz>
Sent: Wednesday, 22 December 2021 9:19 am
To: Robyn Phipps <robyn.phipps@vuw.ac.nz>; Ian Longley <Ian.Longley@niwa.co.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Ackley Aniebietabasi <Ackley.Aniebietabasi@education.govt.nz>
Subject: RE: some thoughts on CO2 guidelines for schools

Good morning all,

I haven't focussed on this conversation and missing the initial 'what are we intending to use this number for' leading into it?

Scott MacKenzie
Programme Director, Ventilation
Mobile 9(2)(a)

From: Robyn Phipps <robyn.phipps@vuw.ac.nz>
Sent: Friday, 17 December 2021 11:21 am
To: Ian Longley <Ian.Longley@niwa.co.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Ackley Aniebietabasi <Ackley.Aniebietabasi@education.govt.nz>; Scott MacKenzie <Scott.MacKenzie@education.govt.nz>
Subject: Re: some thoughts on CO2 guidelines for schools

Thanks everyone for the debate and thought on this matter.

The current policy is that there should be no more transmission in a school than is occurring in the community. Obviously it will be hard to have zero transmission in a classroom if there is a high level of transmission in the homes and shops that staff and students visit, asymptomatic people, those in early stages of infection etc.

I agree that we should be referencing the CIBSE ventilation rates of 10 litres per second per person, which is also the NZ standard for normal times. 1000 ppm is about 9.5 litres/second/person and 800 ppm is about 15 litres/second/person. I'm most comfortable that we can rationally defend the CO2 max level of 800ppm over a 15 minute average.

Rationale for 15 mins is there can be short term peaks if a few visitors come into classroom, eg extra teacher aids/specialist teachers and it gives time for opening a window/door to reduce the CO2 level.

Regards

Robyn

From: Ian Longley <xxx.xxxxxxx@xxxx.xx.xx>
Date: Friday, 17 December 2021 at 10:06 AM
To: Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx>, Ackley Aniebietabasi <xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx>, Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx>, Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx>
Subject: RE: some thoughts on CO2 guidelines for schools

A more philosophical issue is what are we trying to achieve? Zero transmission in schools is one objective, in which case I'd go for 800 (or even lower). By going for 1000 I'd say we're signalling that that is not our objective. Our national switch from elimination to suppression of COVID-19 would imply zero transmission is not our goal. However, I'd argue that's specific to COVID-19 delta variant.

More generally, these are public health and political issues. 9(2)(g)(i)

Ian

From: Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx>
Sent: Thursday, 16 December 2021 3:45 PM
To: Ackley Aniebietabasi <xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx>; Ian Longley <xxx.xxxxxxx@xxxx.xx.xx>; Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx>; Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx>
Subject: RE: some thoughts on CO2 guidelines for schools

Hello all,
Excellent points from Ackley and Ian.

My 2 cents worth:

1. Calculating the percentage risk a student has, over a school day, is very difficult. It requires data on the viral load of the infectious person and the susceptibility of others in the class. These are not well known for Delta for adults, and are even more uncertain for children, or for Omicron, and are of course unknown for the next variant of concern. Instead, I prefer a ratio approach: what is the risk to student A (who is sitting far from the infectious case) compared to student B (who is sitting right next to the infectious case, thus their risk is not strongly affected by ventilation).
2. If we want this ratio to be 1/10 (student A has $1/10^{th}$ the risk of student B) then for a typical 190 m3 classroom with 31 people, we need 5.3 ACH and 1000 ppm CO2 (assuming no air filtration)
   If we want this ratio to be 1/15, we need 8.3 ACH and 800 ppm CO2
   Personally I am happy with 1/10 instead of 1/15, as student A has other opportunities for close contact with the infectious case outside this classroom, and children don't catch COVID-19 easily, etc... however that decision is for others to take, it's outside my lane!
3. ASHRAE recommend, for hospitals, 4-6 ACH for patient rooms, and 6 ACH for examination and treatment rooms, with at least 2 ACH being fresh air (the rest can be recirculated). That's a high standard. By achieving 5 ACH, in a school where we expect fewer highly vulnerable people compared to a hospital, we're already choosing a high safety level
4. CIBSE note that ventilation rates of 10 litres per second per person or less are recommended by a number of official bodies for health and comfort in normal times. 1000 ppm is about 9.5 litres/second/person and 800 ppm is about 15 litres/second/person.

Therefore 1000 ppm meets the ASHRAE recommendation for hospitals and the 10 L/s/person target, and meets my arbitrary $1/10^{th}$ risk ratio.

Another consideration is that setting a threshold at 800 ppm will result in more rooms being identified as needing investigation and remediation. 1000 ppm will keep this list shorter, leaving off the less urgent spaces.

Against that, 800 ppm is commonly used elsewhere and is the default green/orange threshold for many CO2 monitors. There is value in using the same number consistently in all communications.
Cheers,
Mark

From: Ackley Aniebietabasi <xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx >
Sent: Thursday, 16 December 2021 12:12 pm
To: Ian Longley <xxx.xxxxxxx@xxxx.xx.xx >; Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx >; Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx >; Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx >
Subject: RE: some thoughts on CO2 guidelines for schools

Thanks Ian and Mark,

I agree with the practical cases you've listed below, which is consistent with our previous CO^2 measurements in schools, but I'm inclined to suggest that we consider an average of 800 ppm to ensure the extra ventilation needed to prevent transmission, and for consistency with some of the international recommendations.

Thinking about ACH, my understanding from Mark's explanation at the meeting yesterday was that 1000 ppm is about 5.2 ACH, and ideally, our target is for 6 ACH. So, the question that comes on my mind is: What is the ACH and background ventilation rate (l/s/person) for 800 ppm, and what does it equate to in a % risk of infection?

In a typical Avalon classroom in Wellington, we provided a traffic light CO2 monitor, where I set the CO^2 thresholds shown in the bar chart below. In the first phase of the experiment, we provided a pre-designed template and asked the students/teachers to record the CO2 levels based on the green, orange and red peeps.

After two weeks, we went to the school and discussed the results with the students and their class teacher. As reported by Newsroom, "the students identified that often carbon dioxide levels on the electronic monitoring device we provided increased quickly when the windows were closed, but as they opened the windows the levels decreased significantly. The students found it difficult to persuade a relief teacher to keep the windows open on a cold winter day".

This suggested an awareness of what to do when CO2 levels are above the recommended threshold helped to promote environmental competency (reflecting on our discussion with Chris on Tues).

My thoughts are that we should consider a target that will provide the good ACH, background ventilation rate, which will potentially reduce the risk of infection, and consider consistency with international recommendations and our forthcoming on-demand DQLS CO_2 target.

Happy to discuss further.

Nāku noa, nā
Ackley
Aniebietabasi Ackley (Jnr), PhD | Senior Technical Advisor | TPHM School Design Team
TPHM-Te Puna Hanganga, Matihiko | Infrastructure & Digital
https://nz.linkedin.com/in/ackley-aniebietabasi-2b361a85
DDI +6444637590
National Office Mātauranga House
education.govt.nz

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Te Tāhuhu o te Mātauranga
MINISTRY OF EDUCATION

From: Ian Longley <xxx.xxxxxxx@xxxx.xx.xx >
Sent: Wednesday, 15 December 2021 7:46 PM
To: Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx >; Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx >; Ackley Aniebietabasi <xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx >; Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx >
Subject: some thoughts on CO2 guidelines for schools

In principle I'm happy with a 1000 ppm guideline, which I make to roughly equate to a 1% risk of infection over 1 hour (based on numerous assumptions).

I'm mainly concerned about the practical application/implications.

Firstly, I would clarify that this is a **instantaneous** guideline, which in practice should be interpreted as CO2 should not stay over 1000 ppm for at least 5 minutes (or instruments providing running 5-minute averages are fine), followed by immediate **behavioural** action if it does and **training/infrastructural** intervention if it happens persistently over days/weeks.

In practical cases, and looking at our study data, most of our classrooms fall into three categories:

1. Under-occupied or well-ventilated – never get close to 1000
2. Under-ventilated but vacated after within the hour – these tend to get to around 1200 ppm (if normally occupied) by the end of the period
3. Under-ventilated and occupied for > 1 hour (or insufficiently flushed between classes) – these get well over 1200 and over 2000 in many cases

Let's imagine for now we have a visual traffic light indicator which is only either green or red either side of 1000 ppm.

Type 1 are obviously fine.

Type 2 tend to go over 1000 ppm only towards the last half, and maybe even the last 10 minutes of the period. Generally small modifications (1 or 2 extra window openings) are likely to bring CO2 down below 1000. We'd like to hope that after this happening multiple times the teacher will get the gist and open that extra window earlier to pre-empt the monitor going red in which case – job done (depending on how many teachers use the room).

Type 3 are the really problematic ones, but note that there are three interventions:

- Significantly increase ACH (not an option in winter)
- Schedule a "flush" after an hour
- Don't timetable rooms to be used continuously for more than an hour

Note that emptying the classroom for 5 minutes has very limited effect without the flush and the flush is still effective if everyone stays put. The question is – is a 5 minute flush practical?

It may also be worth bearing in mind (and maybe communicating) the non-linear relationship between CO2 and infection risk:

- The longer a room is occupied the more likely CO2 is to level off and stop rising (except in really poorly ventilated cases)
- Infection risk does THE OPPOSITE – growing exponentially with time. Another reason why double-periods without mid-period mitigation might be the biggest risk in schools.

Hope that helps!
Ian

Dr Ian Longley
Principal Scientist - Air Quality
Programme Leader - Atmospheric Environment, Health and Society
9(2)(a)
National Institute of Water & Atmospheric Research Ltd (NIWA)
41 Market Place Viaduct Harbour Auckland New Zealand
Connect with NIWA: niwa.co.nz Facebook LinkedIn Twitter Instagram

Document 2: Discussion between VTAG members and programme team re CO2 testing

F om Ma k Je my
To Ian . ongley Sco t MacKenz e Scott MacKenz e Robyn h pps
Cc Jeff Wil son V cky Evans Jason Chen Ackley Aniebie abasi Renelle G one t
Subject RE nal Results Home Test Set #11 - whe e it takes us next
Date day 7 Janua y 2022 8 18 09 pm
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Hi a l,
A couple of points n case they a e of use

1) Scott, if you need a efe ence fo 10 l/s/pe son and 6 ACH, he e s a passage w th efe ences

"Vent lat on ates of 10 l t es pe second pe pe son a e recommended fo health and comfo t n no mal t mes by a numbe of sou ces [3] The h ghe the vent lat on ate the lowe the nfect on sk

Fo hosp tals ASHRAE ecommends 4-6 a changes pe hou (ACH) fo pat ent ooms 6 ACH fo exam nat on and t eatment ooms and 12 fo a bo ne nfect on solat on ooms w th at least 2 ACH be ng f esh outdoo a n each case and the est may be ec culated f clean [4]

A l t es-pe -second ta get depends on the numbe of people n the oom and a -changes-pe -hou ta get does not We ecommend both types of ta get a e ach eved f poss ble

[3] C BSE Gu de B Heat ng Vent lat ng A Cond t on ng and Ref ge at on (2016)
[4] ASHRAE Standa d 170-2021 – Vent lat on of Health Ca e Fac l t es (Ame can Soc ety of Heat ng Ref ge at on and A -Cond t on ng Eng nee s)"

We also have a ationale fo 5.3 ACH. At this ai change ate, afte 1 hou , a suscept ble pe son n the same oom, but fa enough f om the nfectious case that the ai they b eathe is well mixed, eceives a dose of vi us which s less than 1/10th the dose fo a pe son s tting bes de the infect ous case.
(We assume the pe son sitting next to the infect ous case is 1 met e away and facing the same way).

2) If we a e to compa e pu ging with constant vent lat on, I th nk the isk of t ansm ssion of COVID is best assessed by the total dose of vi us eceived while spend ng a given pe iod in the oom. The efo e we could compa e the effectiveness of pu ging vs. the effect veness of constant vent lat on by the level of PM (o CO2) integ ated ove a given pe iod of time (say a 1h lesson). It should be easy to calculate this fo set ai change ates, I ll have a go.

3) I think the p io ty fo Jason and I is to complete the calculat on algo ithm fo the self assessment tool (we ll include w nd d iven flow) and then un it fo a ep esentative set of class ooms fo diffe ent times of yea in diffe ent cl mates.

Chee s,
Ma k

From Ian Longley Ian.Longley@niwa co.nz>
Sent F iday, 7 Janua y 2022 3 46 pm
To Scott MacKenz e Scott@sapius nz> Scott MacKenzie xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx> Robyn Phipps obyn ph xxx@xxx.xx.xx> Ma k Je my ma k je my@cante bu y ac.nz>
Cc Jeff Wilson xxxxx@xxxxxx.xx.xx> V cky Evans V cky Evans@education govt.nz> Jason Chen jason.chen@cante bu y.ac.nz> Ackley Aniebietabasi ackley.aniebietabas @education.govt.nz> Renelle G one t Rene le G one x@xxxxxxxx.xxxx nz>
Sub ect RE Final Results Home Test Set #11 - whe e it takes us next

Hi Scott

Ag ee with all of that, I think. I like the idea of ai cleane s be ng used tempo a ily wh le mo e pe manent building modifications a e made (if you have enough), but also awa e a cleane allocation/p io it sation p ocess w ll be equi ed.

Rega d ng ongoing studies and evidence to pin ecommendat ons upon, I see it like th s .

1. Solid and easily nte p eted evidence that
   a. c ossflow MUCH mo e effective fo CO2 and PM
   b. egula pu ge 2nd best method
   c. single o mino openings not sufficient and should not be elied upon
   d. ai cleane s (filt ation) effective supplement so long as x, y, z
   e. (could do ANVS again)
   f. I think these can be add essed elatively quickly (one week) at Epuni (o s mila) w th some methodological imp ovements wh ch I can elabo ate on anothe time
2. good p actice fo
   a. c ossflow (what methods a e eliable/va able, influence of weathe)
   b. ai cleane s (speed sett ng, noise acceptabil ty, placement)
   c. these nvolve a longe set of epeated obse vations ove a longe timef ame, p obably best done if the p ocess can be at least pa tly automated (emote cont o led) so that school s v s ted only an hou /day (fo example).
3. Implementation – can teache s/schools follow inst uctions?
   a. G ven Leeds expe ience that the answe will be NO unless this is ca efu ly conside ed

And f nally, my egula equest that any CO2 data s captu ed and sto ed, along with metadata, acco d ng to standa d p otocols whe eve poss ble to max mise lea n ng. Mikael, myself and othe s have long been keen on an "Indoo Ai Quality Obse vato y" that would p ovide th s cent alisation/standa disation to multiple secto s and now seems an exce lent time to explo e that idea fu the .

Ian

From Scott MacKenzie Scott@sap us.nz>
Sent F iday, 7 Janua y 2022 10 58 AM
To Ian Longley Ian.Longley@n wa co.nz> Scott MacKenz e xxxxx.xxxxxxxx@xxxxxxxxx.xxxx nz > Robyn Ph pps obyn xxxxxx@xxx.xx.xx > Ma k Je my ma k je my@cante bu y.ac.nz>
Cc Jeff Wilson xxxx@xxxxx.xx.xx > V cky Evans V cky Evans@education govt.nz> Jason Chen jason.chen@cante bu y.ac.nz> Ackley Aniebietabasi ackley.aniebietabas @education.govt.nz> Rene le G one t Renelle G one x@xxxxxxxx.xxxx xx >
Sub ect RE Final Results Home Test Set #11 - whe e it takes us next

Love it! G abb ng back the talk ng stick noting Robyn s emails as I m typing this type of content fo the pape . Really app ec ate the spit balling, I find it the best way to a ve at sma t and quick gold nuggets:

- 10 lps good efe ence point gives ts elevance and p ominence in bu ld ng pe fo mance (Jeff and Ma k – nudges) and maybe something ou TAG should fo m a solid view/statement on 2 6ACH a l eady common ef point fo the sta t of good ventilation vs 2.5-3.5 being adequate in schools (but maybe less so in this n a chang ng wo ld).
- P og amme pos tioned as COVID esponse to seg egate its aims away f om cu ent DQLS, so we can leave that be fo now noting we a e a cu ent " " guided ne due to COVID but what we lea n/do eventua ly looks into DQLS – so think we ve cove ed that angle.
- Risk-based ta gets needs to app eciate if we a e at g een/o ange/ ed, then down to if we have infect on at this pa ticula school, what cont ols a e in fo ce (distanc ng, coho t ng, masks etc) and also the isk inhe ent n the occupant (age, medical cond tions, vac status, he d immunity etc). We can neve know if the e a e no infected people. Good topic fo the wide esponse wo k within the M nist y to be tasked with and consult us on – I can seek th s inte na ly as an INPUT to ou th nking. V cky something we could pick up with He en s team.
- Ag ee that 800PPM is an a bit a y numbe – eads as such on CDC – you could say with Omic on it now should be lowe , o you could say it now matte s less because it s so t ansmiss ble you w ll need 12 ACH to sta t making a diffe ence – which wi l neve be an option fo schools unless we make them [new] hospitals.
- Really like this type of simpl c ty f om Ian below (though Ackley wi l have thoughts – think I am eflecting discuss on late last yea on 800-1000PPM, we can cement t in at the ght time
  - If you can meet 800-1000 ppm consistently – you e fine in te ms of needing to focus on ventilation-specific st ateg es to minim se COVID-19 ai bo ne t ansmission.
  - If you can stay unde 800-1000 ppm by us ng hou ly o nte -pe iod pu ges – please do. And let s conside ecommending th s as a do anyway st ategy ega dless of ventilation pe fo mance – especially fo high schools who al eady have inte -pe od b eaks (noting coho t management needed alongside)?
  - If you go consistently ove 800-1000 ppm eve y pe iod – imp ove ventilation until you don t. Conside changing go cons stently ove to on ave age go ove so it s m nsu able? Th s is why we need the class oom study esults a e c it call – th s is l kely a REALLY BIG piece of wo k to get schools, and my bed oom to this level.
  - If you can t – now go to f lt at on (which may be temp while othe imp ovements a e sought o pe manent, and noting that the effect of filt ation will NOT be eflected n CO2 data). Yes on that bas s that we have ev dence that lowe ing CO2 also lowe s PM – which NIWA study does not have good data on, but my bed oom test nd cates it does.
  - AND the e will be specific s tuations whe e due to sk p ofile you go to filt at on anyway (Fictitious) a school of 1000 ncludes 50 yea 6-7 k ds, many high isk due to vac status and p e-existing health condit ons, who have class oom with max of 15, 3m desk spacing, assisted ventilation AND in oom filt ation. Seen something like this in the US. That would be an ope at onal management decision suppo ted by ventilation advice.

So should in ou action plan clea ly include

- **Studies (part of GUIDE workstream)**
  - A follow-up cont ol oom study at Epuni whe e we apply the incense PM to epeats of CO2 build-up testing (and which with what I ve now got, we could also nclude steady CO2/PM p oduct on vs vent lat on educt on testing). We need accepted evidence that methods of lowe ing CO2 also moves and lowe s PM (beyond my bed oom test ng), if this type of data is not al eady p oved in othe studies.
  - We push 1 on Epuni and move ts status f om a epeated study to becom ng ou ongoing test lab oom we have continued access to, whe e we keep com ng back to it to test new methods/techniques/technolog es ove the next six months (UVC comes to m nd).
  - We conside if the occupied class oom studies need to continue/by expanded/ epeated to get mo e building type, occupant, changing cont ols etc cove age.
  - Keep a watching b ief on the wo ld a ound us (Ian s ones below, Leeds, SA, etc, etc)
  - Fund ng needs to be discussed ac oss a l of th s as benefit much wide than education domain.
- **Calls to action (part of ASSESS workstream)**
  - Set a ta get 800-1000PPM numbe (s) and associated actions as pe bullets above – and efe ence this f om the vent lat on calculato . We do a cha t/g aphic of this type of bas c advice, but needs to align to existing IEM mate ial/advice (Ackley).
  - We push fo wa d w th the self-assessment toolkit ollout, wh ch will also be backed by an engineer ing ev ew p ocess = we need to know who has what potential p oblem, and what options have al eady been exhausted befo e we h t the bigge buttons.
- **School- mplemented intervention advice (part of SUPPORT workstream)**
  - Joining ou GUIDE ASSESS = he e s what YOU can and should do advice – th s is mainly about wo kflow and managing volume of que es, then lea n ng f om them.
  - BE READY fo the esult of this being high numbe of schools NOT meeting this ta get and what they m ght need to do to fix it- we signa led to Min ste s a high % could via management tact cs, that may no longe be as t ue with Omic on, if we a e not limiting class numbe s etc.
  - L nks to panels below, which s whe e the SCHOOL elects to take action but it doesn t meet the MINISTRY s c ite a to take the same action (e.g. ai filte n eve y class oom).
- **M nistry-implemented interventions (part of ENHANCE workstream)**
  - Supplie panels
    - Eng nee s/fi ms who can do ASSESS p ocess to ou standa d/c ite ia/ equi ed outputs etc.
    - Technology p ovide s of CO2, ai cleane s, ANVS, HVAC, and othe magic devices we suppo t schools p ocu ing di ectly if they choose to do so (may be mult ple panels)
  - Minist y nte ventions (cent alised p ocu ements and deployments, p ovided at va ious scale scena ios depending on ASSESS)
    - ANVS pilot
    - Po table ai cleane s
    - Hyb id systems and components (ext act fans, standalone mixed mode systems fo bath ooms, heat ecove y, sola etc etc) – whe e not p ocu ed at least on a list somewhe e of not a bad thing but not what we e oll ng out at this stage
    - CO2 monito s
    - Maybe othe s (e.g. UVC)
  - Assoc ated we OK w th th s technology types, b ands and p oducts listing unde GUIDANCE (dec s on on if we st ck to tech types in the above o assu ance of pe fo mance of p oducts wh ch is a slippe y slope.

Robyn bet me to the talk ng stick but I now hand t on to..... [next!]

Scott

From Ian Longley Ian.Longley@niwa co.nz>
Sent F iday, 7 Janua y 2022 9 36 am
To Scott MacKenz e xxxxx.xxxxxxx@xxxxxxxxx.xxxx nz > Robyn Ph pps obyn ph xxx@xxx.xx.xx > Ma k Je my ma k je my@cante bu y.ac.nz>
Cc Jeff Wilson j ff.@ h.xxxxx > V cky Evans V x E @ g > Jason Chen j h @ y > Ackley Aniebietabasi l y @ g > Scott MacKenzie S @ > Rene le G one t R ll G @ g >
Sub ect RE Final Results Home Test Set #11 - whe e it takes us next

Hi Scott

N ce look ng document eme ging the e.

My thoughts on you ed question . have we got evidence that suppo ts a decision point at which ACH becomes insuff c ent to meet ou PM goals, yet emains OK fo ou CO2 goals, and we move adopting the eACH/f lt ation st ategy fo a space?

I wonde if some misunde standing has c ept in (as it usually does). This is how I see it.

In my head we have two ventilation goals (mo e co ectly stale-ai emoval/clean-ai del ve y goals) –
1. ou p e-ex st ng "comfo t/lea n ng pe fo mance" goal (as exp essed in DQLS). Th s is chosen to be p otective aga nst adve se effects f om bu ld-up of a ange of contam nants including wate vapou (which p omotes mould), solvents and othe unpleasant chemicals, and the effects of exhaled CO2 on lea ning pe fo mance.
2. ou new COVID-management goals. This s expl c tly to educe the sk of vi us t ansmission. It is cons de ably mo e demanding as the isk is h ghe .

The gene ally ag eed goals a e a ound 5 l t es/pe son/second **averaged over a day** fo #1 and 10 l/p/s **at all times** fo #2. In typical class ooms that equates to a ound 2.5 - 3 ACH fo #1 and 5 – 6 ACH fo #2. The t me element is impo tant because COV D infection can happen much mo e ap dly than the effects that goal #1 is p otecting against.

If you can t achieve that th ough ventilation then you can b ing in filt at on to achieve the same effective ACH.

It s the implementation/monito ing whe e it gets t cky.

We cannot measu e ou goals di ectly so we use ndi ect p oxies. Using CO2 (o any concent at on) to ep esent ai exchange is like t ying to use the depth of wate to ep esent the leakage ate of a wate bath in the a n. It s not as simple as it looks!

If we e NOT using filt ation then we can tu n the two ventilation goals into CO2 ta gets, i.e. 1500 and 800 ppm espect vely. So, theo etica ly if you knew the e we e no nfected people n you class oom 1500 ppm would be sufficient, but you don t, so you aim to achieve 800 ppm f om ventilation as a p ecautiona y measu e. We need to be ve y ca eful w th language, though. The 800 ppm goal is just a way of judging whethe ventilation alone can manage COV D isk – t s nothing to do with the effect of CO2 itself.

If you can meet 800 ppm consistently – you e f ne.
If you can stay unde 800 ppm by using hou ly o inte -pe iod pu ges – please do.
If you go consistently ove 800 ppm eve y pe iod – imp ove natu al ventilation unt l you don t.
If you can t – now go to f lt at on (noting that the effect of filt ation wi l NOT be eflected n CO2 data).

BTW it is my unde standing that 800 ppm ep esents an effect vely a b t a y isk th eshold (isk cannot be educed to ze o). I have seen one a gument that it ep esents a isk of 1% of nfection of one pe son w th delta ove one hou . In p nciple, om c on, o some othe mo e infect ous va ant, would equi e a lowe CO2 value fo the same isk (o you stick with 800 and accept a highe nfection sk). Simila ly you could adopt 1000 o 1200 ppm, acknowledging the highe isk, on the basis of g eate achievab lity, especially if the educed nvestment was mo e effect vely di ected somewhe e else. These a e quest ons fo health people.

I would avoid any ment on of PM goals. PM in class ooms is highly va iable/ andom and the vast majo ity of PM n any class oom has nothing to do with espi ato y ae osols (t s ca pet dust, soap powde , k tchen em ss ons, t affic/heating emissions, etc). We have only stale-ai - emoval o clean-ai -del ve y goals.

The final point is how do you know if you filt ation s achieving anything? Only eally two options at the moment – calculate it and t ust the calculat ons, o do an incense-style expe ment.

In the med um te m I d just like to highlight two st ands of esea ch we e involved n that should come onst eam at some point
1. we e cu ently wo king on code to conve t live CO2 data into live estimate of ACH (so you can judge pe fo mance di ectly to the actual goal, not a p oxy) – hoping to make good p og ess in next few months
2. devices to apidly assess filt ation effectiveness (waiting on fund ng decis on – timef ame next few yea s)

W ll stop the e fo now awaiting ag eement o cha lenge f om the othe s!
Ian

From Scott MacKenzie xxxxx.xxxxxxxx@xxxxxxxx.xxxx.xx >
Sent Thu sday, 6 Janua y 2022 6 03 PM
To Robyn Ph pps xxxx.xxxxxx@xxx.xx.xx > Ma k Je my ma k. e my@cante bu y.ac.nz> Ian Longley Ian.Longley@niwa.co.nz>
Cc Jeff Wilson j ff .@ h > V cky Evans V y.E @ g > Jason Chen j h @ y > Ackley Aniebietabasi j y @ g > Scott MacKenzie S @ > Rene le G one t R ll G @ g >
Sub ect RE Final Results Home Test Set #11 - whe e it takes us next

Hi – sha ing that attached with a subset of the most-engaged aud ence so you (if the mood g abs you) cab pe use whe e th s conve sation s head ng. I ve committed to p oducing an implementation plan by...geez...Monday...which will be made up of two pa ts – one be ng the d scussion on the actual p oblem and ou inte vent on st ategies the second being the mo e mundane time/cost/ esou ce/scope etc plan on how we get it all done. Most of the latte exists in va ious docs/updates al eady, hence why I ve been focuss ng on the fo me .

When pulling togethe these foundation docs I tend to sta t w iting an exec summa y, that gets ove ly ve bose, then then content gets p og essively moved nto the main document as the key points su vive. You w ll see the below has led to cu ent section 1.7, which by its natu e needed p o sections to explain why PM, CO2 and ACH whe e a l the elevant points. I bel eve t maintains the same logical flow but a bit smoothe in the logical jou ney. Defin tely needs a pictu e o two to suppo t (you will spot some late in the doc which should also assist).

At the tend of today s long d afting sess on, my nagging question s – have we got evidence that suppo ts a decision point at which ACH becomes insuff c ent to meet ou PM goals, yet emains OK fo ou CO2 goals, and we move adopting the eACH/f lt at on st ategy fo a space? This s a key facto that will play out "OK, we ve got p etty good ventilation. But t s va liable due to ambient condit ons. O the CO2 peaks, but not so h gh that it s eally wo ying. So we want to ensu e PM s in check and put in a po table ai filte ." How would we app oach the yes/no on th s advice? I know we can say well it won t hu t so put one in anyway , but that sets a p ecedent fo all ooms meeting the same c te ia to then eceive the same solution (wh ch we, o schools may be funding). Is it something I ke PM monito ing to decide? O if CO2 c eeps between nte vals consistently up into (?) 1500 ange? Mag c 8 ball?

Thoughts always welcome, will d scuss with Vicky about getting some wo kshops into the calenda ove the com ng weeks. It s going to be a busy yea – day job o not!

Scott MacKenzie
Programme Direc or, Ven ilat on
Mob! 9(2)(a)

From Robyn Phipps obyn.ph xxx@xxx.xx.nz >
Sent Wednesday, 5 Janua y 2022 11 24 pm
To Ma k Je my ma k.je my@cante bu y.ac.nz> Scott MacKenzie Scott.MacKenz e@educat on govt.nz> Ian Longley xxx.xxxxxxx@xxxx.xx.xx > Rene le G one t Renelle.G one x@xxxxxxxxx.xxxx.xx > Manf ed Plagmann Manf ed.Plagmann@b anz.co.nz> Guy Coulson guy.coulson@n wa.co.nz> Je emy Tuohy Je xxx.xxxxx@xxxxxx.xxxx.nz > B ooke Hollingshead b xxxx.xxxxxxxxxxx@xxxxxx.xxxx.xx > Mikael Boul c m.xxxxxx@xxxxxx.xx.xx > dav d xxxxx@xxxx.xx.xx > Pe y Davy p.davy@gns.c i.nz> Ackley Anieb etabasi Ackley.An ebietabas @education.govt.nz> Vicky Evans xxxxx.xxxxx@xxxxxxxxx.xxxx.xx > Jason Chen j h @ y >
Cc Jeff Wilson xxxx@xxxxxx.xx.xx >
Sub ect Re Final Results Home Test Set #11

Good summa y Scott. In point 3 we should nclude Sola Ai heate s. We found (but d dn t expected) a signif cant eduction in PM in ou p evious study, t s ANV w thout the tempe atu e penalty.

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From Ma k Je my j y@ y >
Sent Wednesday, Janua y 5, 2022 7 37 45 PM
To Scott MacKenz e scott.mackenz e@educat on govt.nz> Ian Longley Ian.xxxxxx@xxxx.xx.xx > Robyn Phipps obyn.phipps@yaw ac.nz> Rene le G one t Renelle.G one x@xxxxxxxx.xxxx.xx > Manf ed Plagmann Manf ed.Plagmann@b anz.co.nz> Guy Coulson guy xxxxxxx@xxxx.xx.xx > Je emy Tuohy Je xxx.xxxxx@xxxxxx.xxxx.xx > B ooke Holl ngshead b ooke.ho lingshead@health govt.nz> M kael Boulic m.boulic@massey ac.nz> dav d xxxxx@xxxx.xx.xx > Pe y Davy p.davy@gns.c i.nz> Ackley Aniebietabasi ackley.aniebietabasi@educat on govt.nz> V cky Evans Vicky.Evans@educat on govt.nz> Jason Chen jason.chen@cante bu y.ac.nz>
Cc Jeff Wilson j ff .@ h >
Sub ect RE Final Results Home Test Set #11

You nailed it he e (but d dn t nail t shut ☺)

From Scott MacKenzie xxxxx.xxxxxxxx@xxxxxxxx.xxxx.xx >
Sent Wednesday, 5 Janua y 2022 6 03 pm
To Ian Longley l al y@ > Robyn Ph pps y h @ > Renelle G one t R ll G @ g > Manf ed Plagmann M f Pl g @ > Guy Coulson G y C l @ > Je emy Tuohy j y T hy@h l h g > B ooke Holl ngshead h ll g h @h l h g > Boulic, M kael l @ y > Ma k Je my j y@ y > david @ 3 > Pe y Davy y@g > Ackley Aniebietabasi l y @ g > V cky Evans V y E @ g > Jason Chen j h @ y >
Cc Jeff Wilson xxxx@xxxxxx.xx.xx >
Sub ect RE Final Results Home Test Set #11

Hi Ian, yes that s the knub of the concept we a e t y ng to nail down that has been bugg ng me ove the b eak. The e s a set of IF/THENs h ding n he e, my comments a e not a ebuttal but hoping to st mulate this conve sation fu the . And because I m in the middle of d aft ng the implementat on plan that d aws in these lines of th nk ng.

You po nt is well made, if I have abso bed t co ectly

a) Any oom, ega dless of how ventilated, will have a continual p esence of PM that needs to be emoved/mit gated in some way and the slowe th s occu s, the highe the isk of t ansm ssion.
b) Whe e it s possible fo a oom s f esh ACH ate to be cons stently h gh, in- oom PM filt ation may se ve little pu pose (f om cost/benefit pe spective) as the h gh f esh ACH al eady being achieved cont nually keeps CO2 and PM levels low.
c) Whe e it is only poss ble fo the oom s f esh ACH ate to be inte m ttently high (pu ge), in- oom PM filt ation MAY se ve a pu pose by keeping PM levels low. The e would be a balance point calc in the e somewhe e that when f esh ACH d ops below a ce tain point vi the effective ACH c eated by an ai cleane , justifies the latte investment [MATH NEEDED].
d) Whe e it s ___ possible fo a oom s f esh ACH ate to be h gh, th s would equate to an ongo ng CO2 PM issue only add essed by change o use, building and/o ventilation system imp ovements – and afte being applied, you e back to (b) o (c).

The p oblem we have with (c) s that it also nd cates the p esence of a CO2 issue which I ag ee is an ssue n ts own ight, that is t eated as an nd cato of COV D-19 t ansmiss on isk but this COVID isk can be m t gated by add essing PM n solat on. We call th s a dilemma. So if you e going to spend $2000 (o whateve $) on a class oom, you look fo a solution that add esses the most isks t can. This leads to an o de of p ecedence fo investment

1) Invest in ensu ng that the existing ventilation solution (be it natu al, mechan cal o hyb id) is cu ently ope at ng as t was designed to do – we e d scove ng cases whe e subsequent changes have been made that counte act the o iginal ventilation des gned pe fo mance.
2) Once done, if you have ach eved (b) above, good job.
3) If not and you e up to (c) o (d), use the class oom calculato to see what you options might be (change usage etc).
4) If an investment is needed, invest n solutions that consistently inc ease f esh ACH ates – fo example upg ades to HVAC, ANVS, ext act/make up fans etc– but only if they get you to (b) – e. imp oved CO2 PM levels.
5) Fo spaces whe e th s cannot be achieved cost effect vely, conside nvesting in in- oom PM filt ation noting you ve most likely got an ongoing CO2 sue n that space that isn t being esolved.

Look fo wa d to ound #3!

Scott MacKenzie
Programme Direc or, Ven ilat on
Mob! 9(2)(a)

From Ian Longley l al y@ >
Sent Wednesday, 5 Janua y 2022 3 31 pm
To Scott MacKenz e xxxxx.xxxxxxxx@xxxxxxxx.xxxx.nz > Robyn Ph pps obyn.ph xxx@xxx.xx.xx > Renelle G one t Renelle.G one t@educat on govt.nz> Manf ed Plagmann Manf ed.Plagmann@b anz.co.nz> Guy Coulson Guy.Coulson@niwa.co.nz> Je emy Tuohy Je xxx.xxxxx@xxxxxx.xxxx.xx > B ooke Holl ngshead h ll g h @h l h g > Boulic, M kael l @ y > Ma k Je my j y@ y > david @ 3 > Pe y Davy y@g > Ackley Aniebietabasi l y @ g > V cky Evans V y E @ g > Jason Chen j h @ y >
Cc Jeff Wilson xxxx@xxxxxx.xx.xx >
Sub ect RE Final Results Home Test Set #11

Hi Scott (and colleagues)

Looks like you ve been busie than I have!

A potentially useful dataset. Howeve just want to take ca e that we e compa ing apples with apples (o a e awa e when we e compa ng apples w th o anges).

These data do ndeed show a 5 – 20 minute "pu ge" is much mo e effective using natu al c oss-flow than filt ation.

Ag eed. But n most cases I don t think that s the choice.

The case fo filt ation is p event ng the bu ld-up that p esents the need fo the pu ge. The pu ge alone doesn t p event inte -pu ge build-up and that p esents a isk (espec ally w th omic on??) On you cha t if filt ation had been unn ng fo an hou the PM would be of the o de of 1% of what t sta ted at an hou ago (.e. it has been fall ng athe than ising as would be the case in an unde vent lated occupied class oom). You the efo e wouldn t eally need to do a pu ge fo COV2 but that s fo CO2 in it s own ight, not SARS-CoV-2, which the filt ation has (99%) taken ca e of.

I see a natu al ai flow pu ge and constant f lt ation as being l ke mask ng and vaccination – both useful laye s that a e mo e effective in comb nat on, g ving esidual p otect on if one fails. Both have costs (heat eplacement o unning cost) and isks of unde -use.

Not that I m p omot ng filt ation he e – just felt that this evidence wasn t the ight evidence to eject it.

Chee s
Ian

From Scott MacKenzie S M @ g >
Sent Wednesday, 5 Janua y 2022 11 40 AM
To Robyn Ph pps xxxx.xxxxxx@xxx.xx.xx > Renelle G one t Renelle.G one t@educat on govt.nz> Manf ed Plagmann Manf ed.Plagmann@b anz.co.nz> Guy Coulson Guy xxxxxxx@xxxx.xx.nz > Je emy Tuohy Je emy.Tuohy@health govt.nz> B ooke Holl ngshead b ooke.ho lingshead@health govt.nz> Boul c, Mikael s.xxxxx@xxxxx.xx.xx > Ma k Je my ma k.je my@cante bu y.ac.nz> david day d@xxx.xx.nz > Ian Longley xxx.xxxxxx@xxxx.xx.xx > Pe y Davy p.davy@gns.c .nz> Ackley An eb etabasi ackley.an eb xxxxxx@xxxxxxxx.xxxx.xx > Vicky Evans xxxxx.xxxxx@xxxxxxxxx.xxxx.nz > Jason Chen jason.chen@cante bu y.ac.nz>
Cc Jeff Wilson j ff .@ h >
Sub ect F nal Results Home Test Set #11

Happy New Yea !

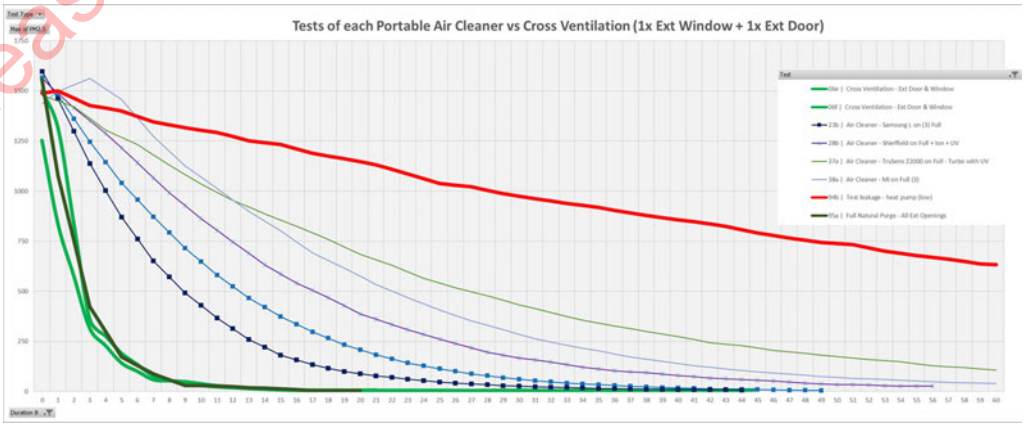
Time to d aw this l ttle s de p oject to a close, but on a nagging theo y yeste day I e- an some tests including the additional NIWA ai cleane s l m n possess on of.

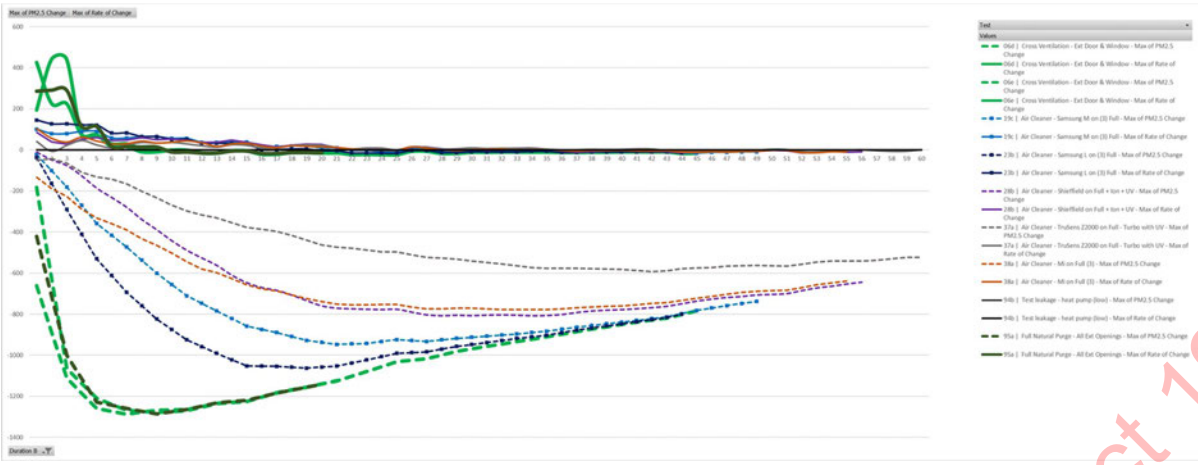
1. Cha t 1 aga n shows how d amatica ly natu al ventilation educes PM2.5 levels compa ed to any filt ation unit tested, but also inte esting is how afte about 20 m ns the eduction in PM2.5 begins to match the natu al ate of decay/settling (ed line).
2. This led me to Cha t 2, looking at what is the deg ee of change each unit s having compa ed to the ed l ne.
3. And then zoom ng in on Cha t 3 showing that afte 20 m ns p etty much a l inte vent ons a e not having much of an effect on educ ng PM2.5 – they a e matching the natu al ate of decay/settling.
4. But it s inte esting to emembe than at the 20 min ma k, each inte vention s at a ve y diffe ent PM level (efe cha t 1) – so it s not l ke a l a e eaching a simila PM no malisat on level when th s begins to occu .
5. A f nal w ap up would see us th ough this oom th ough ou calculato with opening sizes etc measu ed, and also eco ding the specs etc of each of the ai cleane s to see how the data co elates w th thei epo ted CADR etc.

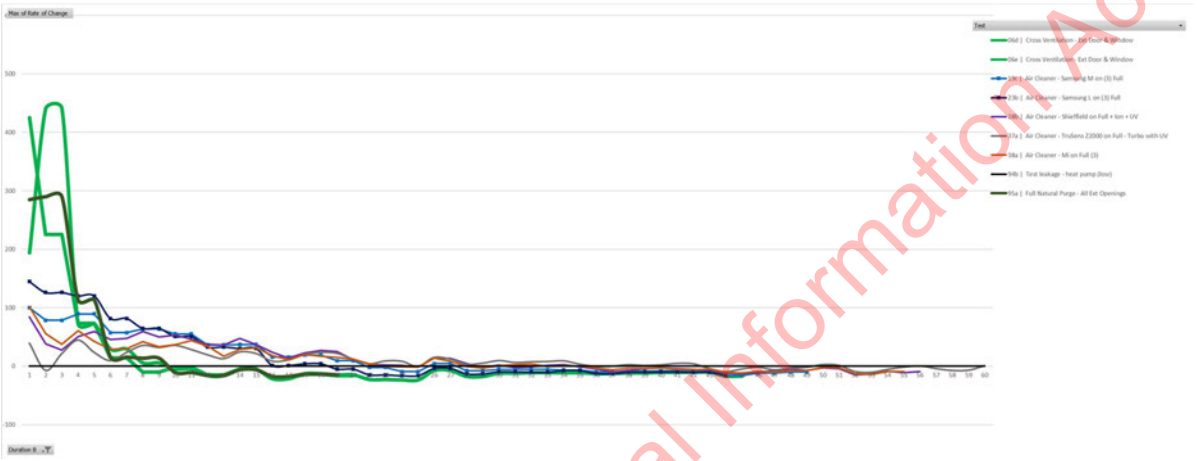
Reta ning my not a scientist caveat, pending challenge it still leaves me with the opin on that it would be bette fo class ooms to be doing hou ly pu ges of 5-10 mins to of esh CO2 (ea l e emails below) AND to educe PM levels and focus on what is the heating/cooling solution you would nt oduce to deal w th the apid change in indoo tempe atu e th s could cause, befo e I d invest in ai f lt at on? And save ai filt ation whe e the oom cannot be pu ged (e.g. natu al vent lat on neffective), o h gh isk (staff ooms?)

"Discuss"

Scott MacKenzie
Programme Direc or, Ven ilat on
Mob! 9(2)(a)







From Ma k Je my [redacted]
Sent Sunday, 2 Janua y 2022 8 20 pm
To Scott MacKenz e Scott@sapius.nz> Jason Chen jason.chen@cante.bu y.ac.nz> Ackley Aniebietabasi Ackley.An eb.xxxxxxx@xxxxxxxxx.xxxx.nz > Ian Longley ian.longley@n.wa.co.nz> Jeff Wilson xxxxx@xxxxxx.xx.nz>
Cc Scott MacKenzie [redacted]
Sub ect RE Home Test Set #10

Happy New Yea eve yone!

This s b i liant Scott!

Looks like the ai cleane helps you each the steady-state PM level qu cke , but does not affect that steady state much, if the e s good ventilation.
Ai cleane s w ll educe total quantity of vi us nhaled by educing the levels ci culating a ound an infect ous pe son.

I don t think the absolute level of PM at the sta t matte s much, if the PM sou ce is constant (like an ncense stick) as, ultimately, the most useful data f om these tests is elat ve ate of eduction.

Hope you a e getting some downtime in between the sc ence mahi!
Chee s,
Ma k

From Scott MacKenzie Scott@sap us.nz>
Sent Thu sday, 30 December 2021 10 49 am
To Ma k Je my ma k.je my@cante.bu y.ac.nz> Jason Chen jason.chen@cante.bu y.ac.nz> Ackley Aniebietabasi xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx > Ian Longley xxx.xxxxxxx@xxxx.xx.nz > Jeff W lson xxxxx@xxxxxx.xx.xx>
Cc [redacted]
Sub ect RE Home Test Set #10

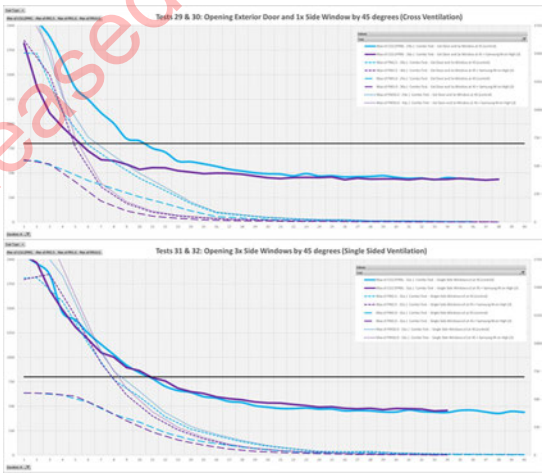
Yeste day I moved into combo testing of openings ai cleane s – stick ng with the Samsung M unit unning on High speed. In all cases I moved the ai cleane out of the di ect ai path when the e was c oss vent lat on.

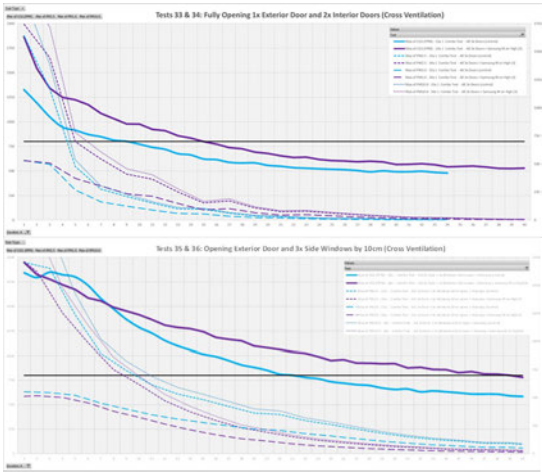
1. Tests 29&30 (45 deg ee opening c oss vent lat on) a e the only ones that saw the ai cleane need up the eduction of CO2 by ~5 m ns – maybe due to wind change, o the ai cleane flow supplementing w nd path – dese ves etest.
2. Tests 31&32 (45 deg ee opening single side ventilation) showed no impact f om unning the ai cleane .
3. Tests 33&34 (3x doo c oss ventilation, 1x exte nal, 2x inte nal) had the ai cleane slow the educt on of CO2 by ~7 mins.
4. Test 35&36 (opening exte io doo and 3x windows by 10cm each) was ove all poo pe fo mance and had the ai cleane l h of CO2 by ~17 mins.

Ac oss all the e we e some m no mp ovements in PM eduction by unning the ai cleane f om 750 down to 100 PM2.5, afte that the ai cleane does seem to have imp oved PM eduction ove no ai cleane p esent.
Need some adv ce on what level of PM you think we should be sta t ng at n this testing to make t ealistic to a class envi onment?

Today will do the full natu al pu ge of the oom w th, and without the ai cleane unning.
I also have a CO2 egulato now so can beg n c eating steady state CO2 elease which w ll be bette than flood ng the oom.

Scott





From Scott MacKenzie
Sent Wednesday, 29 Decembe 2021 11 44 am
To Ma k Je my ma k.je my@cante bu y.ac.nz> Jason Chen jason.chen@cante bu y.ac.nz> Ackley An eb etabasi xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx > Ian Longley xxx.xxxxxxx@xxxx.xx nz > Jeff W lson xxxxx@xxxxxx.xx.xx>
Cc @ g
Sub ect RE Home Test Set #7

Now he e s some nte est ng PM esults – cha ts below a e both same data, bottom appl es a loga thmic scale.

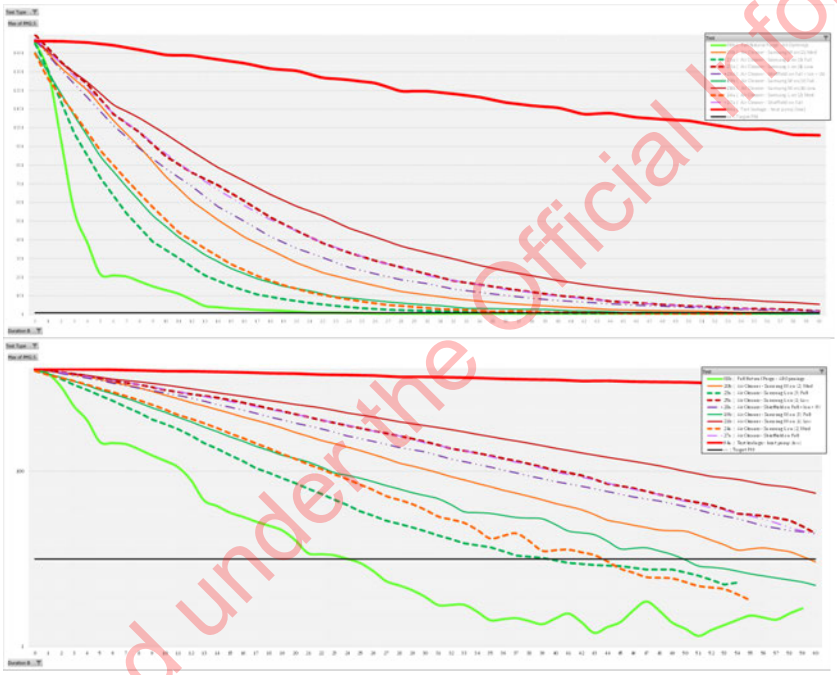
- Afte 35 mins the esult of most ai cleane s sn t much of an imp ovement ove the oom s natu al decay ate (thick ed line).
- Nothing beats the full natu al pu ge, getting us down to 10 PM2.5 with n 25 mins AND has a much faste init al educt on ate (thick g een line).
- Next is Samsung L un t on full (which has 2 fans/filte s) w thin 40 m ns, but only ~4 min imp ovement between H gh and Med um fan settings.
- Samsung M un t on High sett ng takes 50 mins but s othe w se ve y close to L unit n Medium sett ng fo the most pa t.
- Low sett ngs on both Samsung M and L un ts not effective.
- Fo compa ison I d d my Sheffield un t and H gh, not eally in the ballpa k of the Samsung units.

As we know, and I t acked in the data (efe Combo Pivot by Test, and PM Gen P vot), ai cleane s do not add ess CO2 levels. I did some nitial tests of unning the un ts w th doo s open, PM still being gene ated etc but method p oved to not be b lliant – the Samsung unit could not keep up with the inc easing PM f om 1x ncense bu ning, while opening the exte o doo did. So next set s to t y and balance some open ng of doo s/windows to lowe CO2 (and by natu e, PM) as well as ai cleane s unn ng in the oom to also lowe PM2 - eplicat ng the windows model of needing some windows fo CO2 management but wo ied that PM wi l be too h gh.

If you wanted to exit the oom long enough fo an ai cleane to be effect ve in educ ng potentially contaminated PM, you would need to exit fo 40-60 minutes.

But it s looking to me that a 5 10 minute oom pu ge eve y hou with no ai cleane p esent will be significantly mo e beneficial unning a closed oom w th an ai cleane unning then use the money saved on the ai cleane to up the heat ng of the oom post/pu ge.

Scott



From Scott MacKenzie
Sent Monday, 27 Decembe 2021 9 28 am
To Ma k Je my ma k.je my@cante bu y.ac.nz> Jason Chen jason.chen@cante bu y.ac.nz> Ackley An eb etabasi xxxxxx.xxxxxxxxxxxx@xxxxxxxxx.xxxx.xx > Ian Longley xxx.xxxxxxx@xxxx.xx nz > Jeff W lson xxxxx@xxxxxx.xx.xx>
Cc scott.mackenzie@educat on.govt.nz
Sub ect RE Home Test Set #7

Moved on to PM testing using incense st cks – wo ked we l, also did some tests with continual PM gene ation (not shown he e) - these we e all built it up then shut it off.

This shows the Samsung Med um sized un t unning at its fou speeds – low, med, high and auto. I have PM1 0, 2.5 and 10.0 data, ve y little diffe ence between 2 5 and 10 0 though 1.0 always sits lowe (thinking ncense not c eating volume of smalle pa t cles). Inte esting obse vations

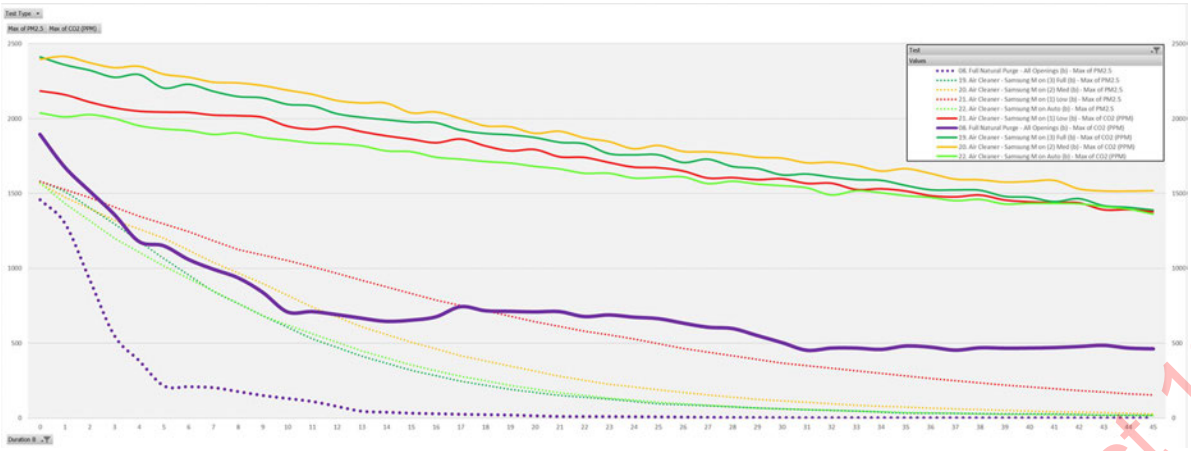
- Fu l f esh ai pu ge of the oom massively mo e effect ve than an ai cleane n educing PM levels
- Only mode ate ga n unning Samsung unit on auto o high, compa ed to med um.
- ZO educt on fo ai cleane s (which we know is not a th ng) shown fo completeness, d op e lects oom s natu al decay.

So opening all doo s and windows fo ~13 m ns achieves what a Samsung unit can ach eve afte ~40 m ns, noting the latte does not imp ove CO2 levels.

Next I m going to un the same test with the Samsung L unit, and maybe 2-3 othe smalle non-Samsung units I have he e.

Then onto combo testing, and active gene ation testing.

Scott



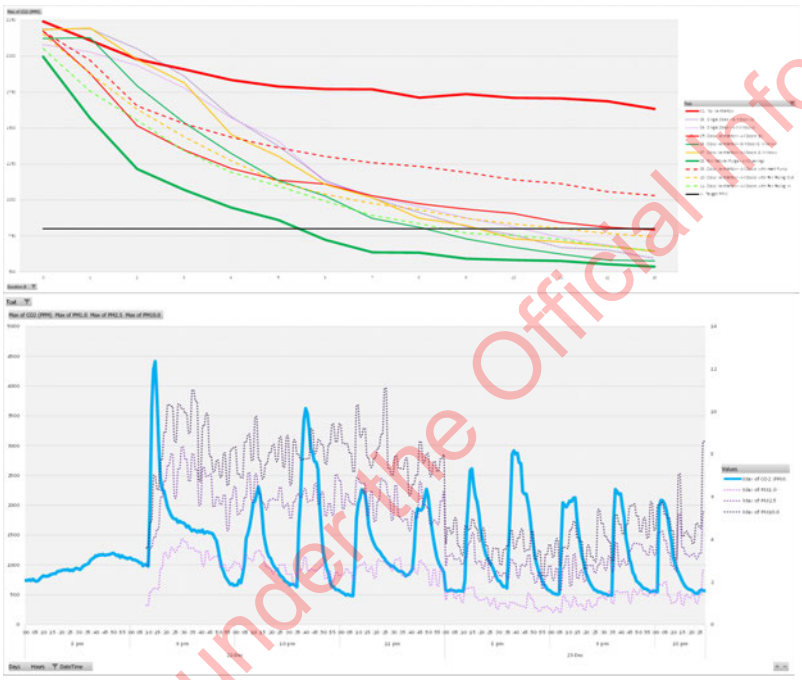
From Scott MacKenzie
Sent F iday, 24 Decembe 2021 11 36 am
To Ma k Ie my' [redacted] > 'Jason Chen' [redacted] > 'Ackley Aniebietabasi' [redacted] > 'Ian Longley' [redacted] > Je f Wilson [redacted]
Cc 'xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx' [redacted]
Sub ect RE Home Test Set #2

Updated obse vations

1. The e emains no substitute fo the pu ge in qu ckly lowe ing CO2 (~5.5mins).
2. Next most effect ve is c oss vent lat on using 1x exte io doo and oppos ng window (~8 m ns), with othe nte io doo s x2 shut (p esumably having these open weakens the ai flow between the exte nal open ngs).
3. C oss ventilation (2) above is ~20% bette than single sided ventilation.
4. Using a po table fan to assist natu al ai flow is a gamble, as fac ng in vs out needs to match the natu al ai flow di ection which can change th ough the day depending on w nd di ection.
5. I am assum ng an ANVS/m xed mode solution would ove come the va iabil ty in (4) th ough inc eased fan powe – to be p oven.
6. Use of a heat pump o any othe f sed device that c eates ts own ai flow, should only be used if ts p oven to always supplement the natu al ai flow di ection – which as noted in (4) can be p oblematic. In th s case the heat pump ai di ection was 90 deg ees f om the natu al ai path (exte io to inte io doo s) – I will e- un th s test with test 06 (exte io doo to window) which might actually supplement the natu al flow towa ds the window.

I ve now included the Pu pleAi data and cu ently showing no co elat on to CO2 and inte ventions – but now I have the datasets associated we I see what happens when we bump up the PM levels.

Ch istmas colou s a e pu ely coincidental.



From Scott MacKenzie
Sent Thu sday, 23 Decembe 2021 7 56 am
To Ma k Ie my [redacted] > Jason Chen [redacted] > Ackley An eb etabasi [redacted] > Ian Longley [redacted]
Cc [redacted]
Sub ect Home Test Set #1

H , fi st set of esults below and wo kings attached, I have all the cont ol data e audit log, spec of windows/ oom/fans etc still to nclude.

Method was to flood oom with CO2 up to 2000-2500ppm, then do inte vention, and (fo most) give it 20 mins. Done back to back last night so simila outdoo conditions. Will edo single sided ventilation fo full 20 min alongside pa tial opening tests next ound. 2x inte io doo s (that eally go nowhe e f om a ventilation pe spective), 1x exte io doo , 3x side windows. Heat pump faces ac oss the path of the exte io doo .

Observations

- Fu ly opening all doo s and windows ("pu ge") wi l educe CO2 to 800ppm in less than 8 minutes.
- Hav ng windows on thei second latch and all doo s open (c oss vent lat on, albeit poo) wi l educe CO2 to 800ppm n less than 15 minutes.
- Then tu ning a po table fan on n the exte io doo way blowing INTO the oom educes this to less than 9 minutes – the efo e fac ng this way s supplement ng the natu al ai di ect on (which you could not dete m ne in the oom).
- Alte natively tu ning the heat pump on, which n this oom competes with the natu al ai flow di ect on f om the exte io doo , g eatly impacts CO2 educt on time.

Have Pu ple Ai data to inco po ate next to see if/how PM levels changed du ing nte ventions.

Scott MacKenzie
Di ec o Sap us td
9(2)(a)
[redacted]

Document 3: Email chain of VTAG members review of draft toolkit letter and CO2 info

From: Mark Jermy
To: Robyn Phipps; Scott MacKenzie; Jason Chen; Ian Longley
Subject: RE: For review - toolkit letter and CO2 info.docx
Date: Monday, 31 January 2022 11:12:59 am
Attachments: DRAFT - toolkit letter and CO2 info40 +RP edits+ MJ edits 31 Jan.docx

Morning all! A few comments from me in addition to Robyn's.

From: Robyn Phipps <robyn.phipps@vuw.ac.nz>
Sent: Sunday, 30 January 2022 9:43 am
To: Scott MacKenzie <scott.mackenzie@education.govt.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Jason Chen <jason.chen@canterbury.ac.nz>; Ian Longley <Ian.Longley@niwa.co.nz>
Subject: Re: For review - toolkit letter and CO2 info.docx

Some comments from me in track changes.

Robyn

From: Scott MacKenzie <Scott.MacKenzie@education.govt.nz>
Date: Friday, 28 January 2022 at 2:54 PM
To: Mark Jermy <mark.jermy@canterbury.ac.nz>, Jason Chen <jason.chen@canterbury.ac.nz>, Ian Longley <Ian.Longley@niwa.co.nz>, Robyn Phipps <robyn.phipps@vuw.ac.nz>
Subject: FW: For review - toolkit letter and CO2 info.docx

Hi first look at letter to go with monitors as discussed, expect some minor tweaks before ready for VTAG review but any immediate reactions/feedback appreciated – as getting our narrative clear on this is now impacting CO2 deployment.

There's a lot of more specific guidance been dropped from this which I hope will find its way onto the online page to be built behind it – your thoughts on it being too light etc appreciated, but special focus is risk/benefit of this initial focus on PPM while the calculator builds up some pace/credence.

Scott MacKenzie
Programme Director, Ventilation
Mobile 9(2)(a)

From: Ian Longley
To: Mark Jermy; Robyn Phipps; Scott MacKenzie; Jason Chen
Subject: RE: For review - toolkit letter and CO2 info.docx
Date: Monday, 31 January 2022 11:18:23 am
Attachments: DRAFT - toolkit letter and CO2 info_IL.docx

Here's mine. Sorry – did these before Robyn's came through so they don't incorporate her o Mark's changes.

Ian

From: Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx>
Sent: Monday, 31 January 2022 11:13 AM
To: Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx>; Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx>; Jason Chen <jason.chen@canterbury.ac.nz>; Ian Longley <xxx.xxxxxxx@xxxx.xx.xx>
Subject: RE: For review - toolkit letter and CO2 info.docx

Morning all! A few comments from me in addition to Robyn's.

From: Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx>
Sent: Sunday, 30 January 2022 9:43 am
To: Scott MacKenzie <xxxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx>; Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx>; Jason Chen <xxxxx.xxxx@xxxxxxxxxx.xx.xx>; Ian Longley <xxx.xxxxxxx@xxxx.xx.xx>
Subject: Re: For review - toolkit letter and CO2 info.docx

Some comments from me in track changes.

Robyn

From: Scott MacKenzie <xxxx.xxxxxxxxx@xxxxxxxxx.xxxx.xx>
Date: Friday, 28 January 2022 at 2:54 PM
To: Mark Jermy <xxxx.xxxxx@xxxxxxxxxx.xx.xx>, Jason Chen <xxxxx.xxxx@xxxxxxxxxx.xx.xx>, Ian Longley <xxx.xxxxxxx@xxxx.xx.xx>, Robyn Phipps <xxxxx.xxxxxx@xxx.xx.xx>
Subject: FW: For review - toolkit letter and CO2 info.docx

Hi first look at letter to go with monitors as discussed, expect some minor tweaks before ready for VTAG review but any immediate reactions/feedback appreciated – as getting our narrative clear on this is now impacting CO2 deployment.

There's a lot of more specific guidance been dropped from this which I hope will find its way onto the online page to be built behind it – your thoughts on it being too light etc appreciated, but special focus is risk/benefit of this initial focus on PPM while the calculator builds up some pace/credence.

Scott MacKenzie
Programme Director, Ventilation
Mobile 9(2)(a)

Document 3a: VTAG members review of draft toolkit letter and CO2 info

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Kia ora,

Along with testing, vaccination, good hygiene, masking (for year 4 and above) and physical distancing, good ventilation is important in minimising the risk of airborne transmission of the virus that causes COVID-19 and is recommended to schools at all settings under the COVID-19 Protection Framework.

Good ventilation removes air from inside and replaces it with clean air from outside, preventing the build-up of potentially contaminated air. The level of carbon dioxide (CO_2) in a space is a good indicator of the freshness of the air. The CO_2 levels will change with the number of people that are present in the room. You can expect to see high levels where there are more people and low levels in unoccupied spaces.

Our advice to schools is that fresh air is best – if your spaces are naturally ventilated, keep all exterior windows and doors as open as you can for as long as you can during the school day, and make sure they're working as originally designed. Having windows open on two sides of the space is best for ventilation.

This means resolving any property concerns which may be impeding good ventilation, including unsticking any windows which may have been fixed shut, replacing any broken window winders and correcting any previous alterations which may be proh biting good ventilation, such as stays that limit how wide a window can be opened.

Schools with mechanical ventilation (typically large roof mounted units with ceiling diffusers) should ensure filters are clean, systems are regularly serviced, and that these are set to use as much fresh air as possible, and begin operating for 30 mins prior to the school day, throughout the school day and for 60 mins until after a space is no longer in use. Note a heat pump is not a ventilator even though you can feel air being pushed out by the unit this is recirculated air that has been heated or cooled. Fresh air is still required. Please contact your property advisor if you you require assistance to identify if your school has mechanical ventilation or a heat pump.

This toolkit includes an Aranet4 CO2 and temperature monitor, and information to help you identify spaces which get good levels of fresh air flow, and those that don't, so we can help you identify the right approaches to improve ventilation. For accurate results the monitor should be located in a central area (such as the teachers desk) but not where people are breathing directly onto the monitor.

Using this CO_2 monitor and toolkit is optional, and what you learn looking at CO_2 levels in one classroom will likely apply to other similar rooms.

You can access more information on our website: https://www.education.govt.nz/ventilation

If you have any concerns or questions about ventilation in your school, please contact your property advisor or our team on ventilation.mailbox@education.govt.nz.

Ngā mihi

Sam Fowler

Associate Deputy Secretary - Property Delivery
Te Puna Hanganga, Matihiko | Infrastructure & Digital

Understanding CO2 levels in the classroom

Indoor ventilation is influenced by how a space is occupied and used, how it is designed to manage temperature, humidity and air flow, and the outdoor conditions.

Good ventilation provides clean air to a room's occupants, while maintaining comfortable and healthy temperature and humidity levels.

Generally, a consistent CO_2 value under 800 ppm indicates that a room is very well ventilated and good ventilation mitigates the risk of transmission of a virus such as COVID-19. Outdoor levels are about 410 ppm so your monitor will never measure below this 410 ppm.

CO_2 levels **in classrooms or other school buildings** fluctuate over the day depending on how many people are using the room, what activities they are doing and the rate of ventilation. Generally, international standards indicate CO_2 levels fluctuating around 1250 ppm over the school day is normal. The below figure shows a normal pattern of CO_2 levels in a classroom over a day.

The CO_2 levels generally build over the start of the day, drop at lunch time or breaks when students are out of the room, and build slightly again over the afternoon. You'll find ākonga might become lethargic or sleepy close to breaks. You can see a normal pattern of CO_2 levels in the below figure.

Short peaks (of around an hour or two) in CO_2 readings and levels above 1000 ppm are common. You'll often find CO_2 levels decrease quickly when the class leaves the room or when windows or doors are opened.

If you've followed our guidance, ensured all windows and doors are opened as they were originally designed to do *(how will they know what the original design was??),* and over a number of days consistently continue to have CO_2 levels above 1250 ppm, please speak to your property advisor.

Sustained CO_2 levels	**What to do**
Less than 800 ppm	Your space is very well ventilated - continue with your current approach.
800-1250 ppm	Your space is well-ventilated. Then windows and doors open as wide as practical, and for as long as practical each school day. Ensure all exterior windows and doors are open, any that aren't open can open as originally intended. This may require some maintenance or minor property improvements.
1251-2000 ppm	CO2 levels of around 1250ppm are normal in schools. Short peaks above 1250ppm throughout the day are normal. If there are consistent sustained elevations in CO2 levels over the school day, as well as the above steps, try: • briefly vacating the room at regular intervals (e.g. 5 minutes per hour) with all windows and doors fully open, to let the air in the room be refreshed • lower the level of vigorous activity performed in the room If following these steps doesn't reduce CO2 levels, please speak to your property advisor – they have access to an online calculator which can provide further information on other solutions or property modifications.
Over 2000 ppm	Short peaks over 2000 ppm can be common in the classroom. If you have followed the above advice and continue to have sustained CO2 levels over 2000ppm, please contact your property advisor

Commented [BP2]:

Commented [AA3]: This is just a place holder. I am working on the graph that would be representative of the colour code and targets.

Commented [RP4]: please insert a different graph. the CO2 levels shown in the graph are a 3hr plus exposure to high CO2 up to 3000 ppm - this graph either needs noting as a cause for action and a be positioned along side a graph of good air or removed.

Document 3b: VTAG members review of draft toolkit letter and CO2 info

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Kia ora,

Along with testing, vaccination, good hygiene and physical distancing, good ventilation is important in minimising the risk of airborne transmission of the virus that causes COVID-19 and is recommended to schools at all settings under the COVID-19 Protection Framework.

Good ventilation removes stale air from inside and replaces it with clean air from outside, preventing the build-up of potentially contaminated air. The level of carbon dioxide (CO_2) in a space is a good indicator of the freshness of the air.

Our advice to schools is that fresh air is best – if your spaces can be naturally ventilated, then maximise this by keeping all exterior windows and doors as open as you can for as long as you can during the school day, and make sure they're working as originally designed. If this makes the classroom too hot or cold we recommend this is mitigated separately through additional heating or cooling, rather than sacrificing ventilation and prevention of infection.

Commented [IL1]: I've just invented a policy here that others may need to support or challenge

This means resolving any property concerns which may be impeding good ventilation, including unsticking any windows which may have been fixed shut, replacing any missing window winders and correcting any previous alterations which may be proh biting good ventilation.

Schools with mechanical ventilation should ensure filters are clean, systems are regularly serviced, set to use as much fresh air as possible, and begin operating prior to the school day until after a space is no longer in use.

This toolkit includes an "Aranet4" CO2 and temperature monitor, and information to help you identify spaces which get good levels of fresh air flow, and those that don't, so we can help you identify the right approaches to improve ventilation.

Using this CO2 monitor and toolkit is optional, and what you learn looking at CO2 levels in one classroom will likely apply to other similar rooms.

Commented [IL2]: Unfortunate as it prevents a proper audit, and proper evaluation of the effectiveness of guidance provided

You can access more information on our website: https://www.education.govt.nz/ventilation

If you have any concerns or questions about ventilation in your school, please contact your property advisor or our team on ventilation.mailbox@education.govt.nz.

Ngā mihi

Sam Fowler

Associate Deputy Secretary - Property Delivery
Te Puna Hanganga, Matihiko | Infrastructure & Digital

Understanding CO_2 levels in the classroom

Indoor ventilation is influenced by how a space is occupied and used, how it is designed to manage temperature, humidity and air flow, and the outdoor conditions.

Good ventilation provides clean air to a room's occupants, while maintaining comfortable and healthy temperature and humidity levels.

CO_2 is emitted into the room on human breath, and as such measured levels of CO_2 can be used as a proxy for levels of exhaled virus particles if there were an infectious person in the room. There is no safe threshold value for CO_2, but generally, a consistent CO_2 value under 800 ppm indicates that a room is well ventilated with stale breath being promptly removed, mitigating the risk of transmission of a virus such as the one causing COVID-19. Poor ventilation, represented by elevated CO_2 levels, is also associated with reduced concentration and lethargy.

CO_2 levels **in classrooms or other school buildings** fluctuate over the day depending on how many people are using the room, what activities they are doing and the time of year. In typical classrooms CO_2 levels fluctuate between 410 and 1500 ppm over the school day. The below figure shows an example of a typical pattern of CO_2 levels in a classroom over a day.

The CO_2 levels generally build over the start of the day, drop at lunch time or breaks when students are out of the room, and build slightly again over the afternoon. You might find ākonga might become lethargic or sleepy close to breaks or when returning to the classroom after a break outside if CO_2 is elevated. You can see a normal pattern of CO_2 levels in the below figure.

Short peaks (of around an hour or two) in CO_2 readings and levels above 1250 ppm, although common in classrooms, are higher than desired and require attention. You'll often find CO_2 levels decrease quickly when windows or doors are opened or the class leaves the room.

If you've followed our guidance, ensured all windows and doors are opened as they were originally designed to do, and over a number of days consistently (e.g. more often than not) continue to have CO_2 levels over 1500ppm, please speak to your property advisor.

Ian's commentary:
What's missing is HOW we suggest the Aranets are used and what actions should be taken. This might be for later, or somewhere else, but putting this here now for your consideration.

A key point is the day-to-day period-to-period variability.
If you get below 800 in one period it does NOT mean that the room is ALWAYS well ventilated, just that either a) it was during that period or b) occupancy/activity was low.

Commented [IL3]: Why 1250? Do levels between 800 and 1250 require attention or not? Seems inconsistent

Commented [IL4]: Again, consistency!

Commented [BP5]:

Commented [AA7]: This is just a place holder. I am working on the graph that would be representative of the colour code and targets.

Similarly if you get 2000 ppm in one period there's also not necessarily anything wrong with the room.
It's not whether the levels are "sustained" but regularly repeated.

Final point – the research community (like IAQRC for instance) should pretty easily be able to come up with a supplementary assessment calculator based on continuous CO2 data, so long as the Aranets are set up to send data to the cloud.

So here's my suggestion….

We recommend that CO2 is measured in a given classroom over a few days to account for the potentially wide variability in results between classes.

Watch out for brief jumps in CO2 – they can be ignored as they are likely to be caused by someone breathing very close to the monitor. Only values sustained for 15 minutes or more should be considered as representative of ventilation in the classroom.

The most representative way to assess CO2 levels is to consider the approximate maximum value (sustained over 15 minutes or more) during a teaching period. This is most easily done using the app to review the complete data at the end of the day.

Comparing observed values to the table below will give an assessment of ventilation for any given teaching period. As results will often vary between periods we recommend that the classroom is assessed over 10 or more teaching periods to distinguish between **temporary** issues which may be solved through simpler changes in door/window usage and **persistent** issues that may require the property manager's intervention.

Sustained CO_2 levels	What to do
Less than 370 ppm	There is a global background level of CO2 (approx. 413 ppm and slowly rising as of Feb 2022). Some small error in your CO2 sensor reading is normal and acceptable. However, if you observe sustained values well below 370 ppm then your sensor may still be used but be aware that it will be under-reading.
Less than 800 ppm	Your space is very well ventilated - continue with your current approach. However, values above 600 ppm at the **start** of a period may mean the room was insufficiently ventilated previously and still contains stale air from a previous class. Fully open doors and windows for 15 minutes to flush out any remaining stale air.
800-1250 ppm	Your space is well-ventilated, but should be improved where practical Open windows and doors as wide as practical, and for as long as practical each school day. Ensure all exterior windows and doors are open, and any that aren't open can open as originally intended. Compensate for any excessive heat loss or gain with supplementary heating or cooling. This may require some maintenance or minor property improvements.
1251-2000 ppm	CO2 levels of around 1250ppm are common in schools

Commented [IL6]: Presuming you're providing access to that?

Commented [IL8]: "sustained" needs defining or replacing. What I think we actually mean is – maximum value that is sustained for 15 minutes or more

Commented [IL9]: Can these be presented more as fuzzy bands? See figure below

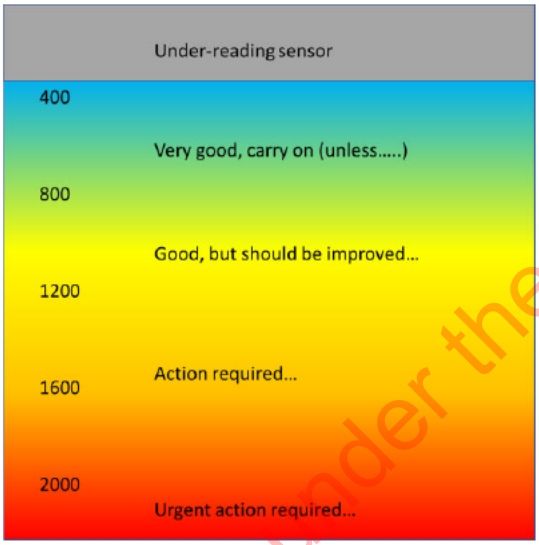
Commented [IL11]: "normal" implies acceptable

Commented [IL12]: Not sure of the point of this statement. So what?

Commented [IL10]: NO! don't agree. Strongly implies a hard boundary which is not defendable

	Short peaks (few minutes) above 1250ppm throughout the day are usually unrelated to ventilation and can be discounted. If there are consistent sustained elevations in CO2 levels (>15 minutes) over the school day, **as well as the above steps**, try: • briefly vacating the room at regular intervals (e.g. 5 minutes per hour) with all windows and doors fully open, to let the air in the room be refreshed • lower the level of vigorous activity performed in the room If following these steps doesn't reduce CO2 levels, please speak to your property advisor – they have access to an online calculator which can provide further information on other solutions or property modifications.
Over 2000 ppm	Short peaks (few minutes) over 2000 ppm can be common in the classroom but are not a cause for concern. **If you have followed the above advice** and continue to have sustained (>15 minutes) CO2 levels over 2000ppm, please contact your property advisor

Ian's version…



Document 3c: VTAG members review of draft toolkit letter and CO2 info

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Kia ora,

Along with testing, vaccination, good hygiene and physical distancing, good ventilation is important in minimising the risk of airborne transmission of the virus that causes COVID-19 and is recommended to schools at all settings under the COVID-19 Protection Framework.

Good ventilation removes air from inside and replaces it with clean air from outside, preventing the build-up of potentially contaminated air. The level of carbon dioxide (CO_2) in a space is a good indicator of the freshness of the air.

Our advice to schools is that fresh air is best – if your spaces are naturally ventilated, keep all exterior windows and doors as open as you can for as long as you can during the school day, and make sure they're working as originally designed.

This means resolving any property concerns which may be impeding good ventilation, including unsticking any windows which may have been fixed shut, replacing any missing window winders and correcting any previous alterations which may be proh biting good ventilation.

Schools with mechanical ventilation should ensure filters are clean, systems are regularly serviced, set to use as much fresh air as possible, and begin operating prior to the school day until after a space is no longer in use.

Enclosed with this letter is an Aranet4 CO2 and temperature monitor, and further information about CO2 in classrooms. This is intended for you to use in spaces that you have concerns around to see whether they are achieving good levels of fresh air flow when in use, and for those that don't, help us work with you to identify the right approaches to improve ventilation.

You can access more information on our website: https://www.education.govt.nz/ventilation

Commented [SF1]: At the link we need to make sure all our technical advice is in place.

If you have any concerns or questions about ventilation in your school, please contact your property advisor or our team on ventilation.mailbox@education.govt.nz.

Ngā mihi

Sam Fowler

Associate Deputy Secretary - Property Delivery
Te Puna Hanganga, Matihiko | Infrastructure & Digital

Understanding CO2 levels in the classroom

Indoor ventilation is influenced by how a space is occupied and used, how it is designed to manage temperature, humidity and air flow, and the outdoor conditions.

Good ventilation provides clean air to a room's occupants, while maintaining comfortable and healthy temperature and humidity levels.

Generally, a consistent CO_2 value under 800 ppm indicates that a room is very well ventilated and good ventilation mitigates the risk of transmission of a virus such as COVID-19.

CO2 levels **in classrooms or other school buildings** fluctuate over the day depending on how many people are using the room, what activities they are doing and the time of year. Generally, international standards indicate CO2 levels fluctuating around 1250 ppm over the school day is normal.

The CO2 levels generally build over the start of the day, drop at lunch time or breaks when students are out of the room, and build slightly again over the afternoon. You can see a normal pattern of CO2 levels in the below figure.

Short peaks (of around an hour or two) in CO2 readings and levels above 1250 ppm are normal and shouldn't be a cause for concern but should be a prompt to consider what steps could be taken to in response. You'll often find CO2 levels decrease quickly when the class leaves the room or when windows or doors are opened.

If you've followed our guidance, ensured all windows and doors are opened as they were originally designed to do, and taken steps to reduce occupancy, activity or increase times when rooms are vacated and over a number of days CO2 levels consistently continue to be towards 2000ppm, please speak to your property advisor.

Commented [AA2]: This is just a place holder. I am working on the graph that would be representative of the colour code and targets.

Sustained CO_2 levels	**What to do**
Less than 800 ppm	Your space is very well ventilated - continue with your current approach.
800-1250 ppm	Your space is well-ventilated. Open windows and doors as wide as practical, and for as long as practical each school day. Ensure all exterior windows and doors are open, any that aren't open can open as originally intended. This may require some maintenance or minor property improvements.

	Consider briefly vacating the room, changing activity or lowering the occupancy at times through the day to support the refreshment of air in the space.
1251-2000 ppm	CO2 levels of around 1250ppm are normal in schools. Short peaks above 1250ppm throughout the day are also normal. If there are consistent sustained elevations in CO2 levels over the school day try: • Ensuring all exterior windows and doors are open, any that aren't open can open as originally intended • briefly vacating the room at regular intervals (e.g. 5 minutes per hour) with all windows and doors fully open, to let the air in the room be refreshed • lower the occupancy or the level of vigorous activity performed in the room If following these steps doesn't reduce CO2 levels, please speak to your property advisor – they have access to an online calculator which can help to identify what approaches might improve the ventilation in the space.
Over 2000 ppm	If you have followed the above advice and continue to have sustained CO2 levels over 2000ppm, please contact your property advisor

Commented [PD3]: Just a suggestion as to whether this is worth repeating, repeating, repeating, repeating?

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

MINUTES

Ventilation Technical Advisory Group (VTAG)

Date:	Wednesday 13 April 2022		
Time:	11.00 – 12.00		
Venue:	MS Teams		
Core Members:	Guy Coulson (Chair)	Manfred Plagmann	Mark Jermy
	Ian Longley	Mikael Boulic	Perry Davy
Attendees:	Scott MacKenzie	Vicky Evans	Ackley Aniebietabasi
	Renelle Gronert		
Secretariat:	Anastasia King		
Apologies:	Robyn Phipps	David Fullbrook	Jeremy Tuohy
	Brooke Hollingshead	Olivia Leckner	

Minutes:

Apologies received from Robyn, Jeremy, and Brooke.

Minutes from 6 April meeting read and approved.

Topic	Discussion
1. Actions/ Decisions (Guy Coulson - Chair)	Out of scope
2. MOH Update (Jeremy > Scott)	Out of scope

Topic	Discussion
3. Finalise VTAG Terms of Reference (TOR) (All)	Out of scope
4. Outline of Ventilation Messaging for Term 2 (Scott)	• Scott provided an overview of the ventilation content that is to be updated as we move into the winter months. • Scott acknowledged that we would include advice for schools to test their heating systems before winter to ensure circuit breakers etc are not tripped. • The group were advised that Scott is in discussions with Nanogirl Labs to produce an online short film/production exploring ventilation in winter. • Scott is seeking feedback from the group on the Website Content Review document an in the meantime the team will continue drafting this content. The aim is to have the updated content live by the 29 April 2022. • Scott requested the meeting scheduled 27 h April will be used to do a final VTAG review of the updated ventilation messaging. **Action:** **VTAG 0015** Members to provide feedback on Web Site Content review ASAP.
5. Other business	Out of scope

Topic	Discussion
	Out of scope
	Media Presentation – Ian Longley Discussion held over comments made in a media presentation relating to 800ppm and how it was construed, stating that you only start to reduce risk of infection once you hit 800ppm or below. The quote from the interview read as follows: "international studies are showing that to reduce the risk of Covid-19 transmission, you really need to increase ventilation so that CO2 stays below about 800 ppm" Ian requested VTAG members to agree on the record that there is a risk at any value above background and the risk linearly increases as the CO2 increases. 800 ppm is widely used as an indicator for action. Everyone agreed.
6. Future agenda items	Out of scope

Out of scope

Out of scope

Document 5: Email to VTAG members providing information ahead of 27/04/22 meeting

Sofia Craig

From: Scott MacKenzie
Sent: Tuesday, 26 April 2022 10:26 pm
To: Robyn Phipps; Brooke Hollingshead; David Fullbrook; Guy Coulson; Ian Longley; Jeremy Tuohy; Manfred Plagmann; Mark Jermy; Mikael Boulic; Perry Davy; Jason Chen; Alexis Sutherland
Cc: Olivia Leckner; Ackley Aniebietabasi; Vicky Evans; Renelle Gronert
Subject: RE: VTAG Weekly Meeting - winter guidance documents for review tomorrow
Attachments: 20220426 MoE Vent Web Content - for VTAG review V0-4 DRAFT.docx; Promoting air flow v2.pdf; 20220426 Pre-Winter Checklist - V0-2 DRAFT.docx

Importance: High

Good evening VTAG members, and apologies for the late issue of this – hot off the press, so to speak, after a massive effort by the internal team.

Wednesday's VTAG session will focus on our revised 'Term 2' guidance, encapsulated in the three attachments: Web site content (revised following last week's VTAG and internal feedback), promoting air flow in winter and a pre-winter checklist. A supplementary poster ('bubble diagram') is still WIP. My aim is, by the end of the session tomorrow, to confirm that VTAG supports the guidance within and it is consistent of VTAG's advice to the Ministry. I do not intend for VTAG to word smith the advice, unless there is specific phrasing you believe needs to be adopted.

Acknowledging we have not provided time for advance review, below I've outlined the key questions where clear direction from VTAG is appreciated and (to my recollection) not already covered in conversations to date. If reviewing the attached web content, look for the green highlights as being the areas directly relating to this. The poster will generally be (re-)aligned to the web content if it changes. The checklist provides some additional guidance, including some specifics VTAG have previously recommended (e.g. pre-run of heating systems).

Feedback on all is welcome to achieve the above objective. Pending your views, the key discussion points proposed for VTAG discussion tomorrow are as follows:

	Topic	Description	Priority
1.	**Describing temperature differential**	How we have described 'air flow behaves differently at different temperatures' – we have struggled to concisely describe this without being too technical, or too simple.	Low
2.	**Dilution vs spread**	For any solution that moves around air in the room (e.g. heat pumps, fans), be it with or without fresh air being introduced, what is our position between the potentially competing views on this potentially spreading infected particles around the room increasing infection risk, versus this diluting concentrations of particles and decreasing infection risk?	High
3.	**Ceiling fans**	As an extension of (2), our advice for use of ceiling fans to assist natural ventilation noting results of the most recent studies (Ackley/Ian/Jason/Lexi can present/discuss this data.	Medium
4.	**Colder days 'rules of thumb'**	Is VTAG comfortable with how we have presented this 'simplified' guidance (i.e. the 5cm partially opening windows, 10cm comparator to PACS, 3 minutes to flush a room).	High
5.	**Other colder days advice**	As an extension of (4), reviewing the new bullets added/refined/discussed in the first pass of VTAG review (preheating, offset heating, wet clothes out, sensitive people).	Low

6.	**Air cleaner comparators**	Similar to (4), how we best explain how an air cleaner compares to fresh air ventilation – yes we know apples to oranges, but not in the eyes of the public.	High
7.	**Air cleaner specs**	Confirm comfortable with short-form description of 'panel of experts' recommendation for spec (aligns to recent RFP at a summary level).	Medium

It is a one-hour session and again apologies for timeline crunch, my suggestion is we do a first pass of these to work out 'no brainers' and close off as much as possible, before we get stuck into (or stuck on) ones that may be more problematic.

The aim is to have this published online this Friday, ahead of Term 2 commencing. This is a definite 'rubber hits the road' moment for all our work to date.

Advance comments welcome. Thanks,

Scott MacKenzie | Programme Director
Te Puna Hanganga, Matihiko | Infrastructure & Digital
Mobile 9(2)(a)

From: Ventilation Mailbox <Ventilation.Mailbox@education.govt.nz>
Sent: Tuesday, 26 April 2022 4:22 pm
To: Robyn Phipps <robyn.phipps@vuw.ac.nz>; Ackley Aniebietabasi Ackley.Aniebietabasi@education.govt.nz; Brooke Hollingshead <brooke.hollingshead@health.govt.nz>; David Fullbrook <david@e3bw.co.nz>; Guy Coulson <guy.coulson@niwa.co.nz>; Ian Longley <ian.longley@niwa.co.nz>; Jeremy Tuohy <Jeremy.Tuohy@health.govt.nz>; Manfred Plagmann <manfred.plagmann@branz.co.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Mikael Boulic <m.boulic@massey.ac.nz>; Perry Davy <p.davy@gns.cri.nz>; Scott MacKenzie <Scott.MacKenzie@education.govt.nz>; Renelle Gronert <Renelle.Gronert@education.govt.nz>; Vicky Evans <Vicky.Evans@education.govt.nz>; Jason Chen <Jason.Chen@education.govt.nz>; Alexis Sutherland <Alexis.Sutherland@education.govt.nz>
Cc: Olivia Leckner <Olivia.Leckner@education.govt.nz>; Olivia Leckner <olivia.leckner@sweeneyvesty.com>
Subject: RE: VTAG Weekly Meeting

Good evening everyone, see below

- Agenda M16 VTAG 27 Apr 22
- Draft Minutes M15 VTAG 20 Apr 22

Scott will forward the updated website content and bubble diagram documents (as attachments) later this evening.

Kind regards
Anastasia

-----Original Appointment-----
From: Anastasia King **On Behalf Of** Ventilation Mailbox
Sent: Monday, 7 March 2022 8:44 am
To: Robyn Phipps; Ackley Aniebietabasi; Ventilation Mailbox; Brooke Hollingshead; david; Guy Coulson; Ian Longley; Jeremy Tuohy; Manfred Plagmann; Mark Jermy; Mikael Boulic; Perry Davy; Scott MacKenzie; Renelle Gronert; Vicky Evans; Anastasia King
Cc: Olivia Leckner; Olivia Leckner
Subject: VTAG Weekly Meeting

When: Wednesday, 27 April 2022 1:00 pm-2:00 pm (UTC+12:00) Auckland, Wellington.
Where: Microsoft Teams Meeting

Good afternoon everyone,

An agenda and draft minutes and supporting papers will be sent out by midday Monday each week.

Kind regards
Anastasia

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting

Learn More | Meeting options | Legal

Document 5a: Attachment to email for 27/04/22 meeting

Pre-Winter Ventilation Checklist:

Making sure indoor spaces are well ventilated and have lots of fresh air is recommended for schools. This applies at all levels of the COVID-19 Protection Framework in addition to using face coverings, physical distancing, good hygiene and other health measures.

Schools can use this checklist to help you to prepare for the winter session ahead. The bigger the temperature difference between the outside and inside, the more efficiently fresh outside air is drawn in through open windows. This allows good ventilation to be achieved on colder days with windows partially open, which helps to maintain a comfortable indoor temperature.

Room Name: _____

Date: _____

Openable windows and doors:

Most schools are designed to be naturally ventilated, with opening windows and doors providing fresh air. For your naturally ventilated spaces, please check:

1.	All windows open as originally designed and have not been fixed or painted shut.	☐
2.	All windows can open freely without having to be forced.	☐
3.	Any window winders, hinges, catches or closers that are missing or broken, have been remediated.	☐
4.	Window or security latches are able to hold windows partially open by small amounts – for example 2cm, 5cm, and 10cm.	☐
5.	Exterior doors that are generally sheltered from adverse weather can be held or latched partially open, if this is required to boost the flow of fresh air.	☐
6.	Interior doors that connect to internal corridors or other circulation spaces can be held or latched partially open, if this is required to create a cross flow of air.	☐

Heat pumps and other heating systems

Naturally ventilated spaces can have differing heating systems including boilers/radiators, heat pumps and fitted electric heaters. Please check:

1.	The room's heating system(s) are working as originally designed and intended.	☐
2.	Ensure that regular cleaning or maintenance on heating system(s) are up to date.	☐
3.	Run the heating at its highest setting for a period to test that it performs as expected and doing so does not create other issues, e.g. tripping circuit breakers.	☐

4.	Prior to the coldest time of the winter season, trial setting the heating system(s) with windows open to determine how you might maximise the flow of fresh air while also maintaining a comfortable indoor temperature.	☐

Ducted mechanical ventilation systems (if fitted)

Ducted mechanical ventilation systems automatically source fresh air from the outside while also managing the temperature of the room. One way to identify if your space has a ducted mechanical ventilation system is to look for vents in the ceiling that bring in fresh air or extract old air.

Configuration and maintenance of ducted ventilation systems should only be done by appropriately skilled technicians. Please check:

1.	The system has been recently checked, cleaned and maintained by an appropriately skilled technician.	☐
2.	This system has been configured to come on at least two hours before the start of the school day, and to stay on for two hours after the school day ends.	☐
3.	Prior to the coldest time in the winter season, ensuing the system is successfully managing the amount of fresh air brought it (as measured by a CO_2 monitor) while maintaining a comfortable indoor temperature.	☐

Carbon Dioxide (CO_2) monitoring

Measuring CO_2 levels indicates how well-ventilated a room is. When in use, portable CO_2 monitors are to be positioned at around student head height, away from doors and windows, out of direct sunlight, and at least 1m away from the closest people. While the room is occupied, please:

1.	Use your senses to determine if the room feels stuffy or has lingering smells, and if so, follow our guidance to try and improve ventilation.	☐
2.	If the concern is not quickly alleviated, next try performing intermittent spot checks through the day by placing your portable CO_2 monitor in the room for at least 5 minutes then reviewing the CO_2 levels against our published guidance.	☐
3.	If the spot check indicates there may be consistent and sustained CO2 levels over the school day, next leave your portable CO2 monitor in the room for at least a full day to gather readings that can be shared with your Ministry Property Advisor alongside details of the room's dimensions, number of students, use of heating and window openings.	☐

** NOTE short peaks in CO_2 levels over 1250ppm throughout the day are common, and peaks over 2000ppm can occur. If you have followed the published guidance and continue to have consistent and sustained CO_2 levels over 2000ppm, please contact your Minister property advisor.*

Further assistance

- Please contact your Ministry property advisor if you require additional support to address any ventilation concerns, or you can contact the Ministry's ventilation team on ventilation.mailbox@education.govt.nz.

- A technical ventilation calculator tool is used by the Ministry's ventilation team to further assess what property improvements may be needed to address ventilation challenges. If requesting additional support, the team will require specific details of the room's usage, dimensions, doors, windows and window openings, supporting floor plans and photos, and any CO_2 readings that are available.

- Ventilation guidance for all schools is available online: https://temahau.govt.nz/covid-19/advice-schools-and-kura/ventilation-schools.

Document 5b: Attachment to email for 27/04/22 meeting

Ministry of Education: "Term 2" Ventilation Online Guidance

Ventilation Technical Advisory Group (VTAG) Content Review - Final Draft

Dated 26 April 2022

IN CONFIDENCE – NOT FOR DISTRIBUTION – SUBJECT TO INTERNAL APPROVALS

Legend:

CYAN	=	Headings
GREEN	=	VTAG area of interest / discussion
YELLOW	=	Ministry review still WIP

L1 page: Ventilation in schools

H1: Ventilation in schools

Good ventilation helps slow the spread of the virus that causes COVID-19.

Making sure indoor spaces are well ventilated and have lots of fresh air is always recommended for schools. This applies at all levels of the COVID-19 Protection Framework in addition to using face coverings, physical distancing, good hygiene and other health measures.

The best way to maximise ventilation is to open all windows and doors as much as possible, and whenever it is practical to do so. The exception to this is spaces that are fitted with ducted air conditioning systems (excluding heat pumps), which do not rely on opening windows to bring in fresh air.

Follow our guidance to fine-tune your school's ventilation strategies to maintain comfortable indoor temperatures while achieving good ventilation.

Subheading: Ventilation help in winter

Air flow behaves differently at different temperatures – for example, the bigger the temperature difference between outside and inside, the more efficiently fresh outside air is drawn in through open windows. This means ventilation can work better during cold weather, so you can still achieve good ventilation with windows just partially open.

There are several ways to do this depending on your school's design, how each space is being used and the outdoor conditions. **Read our tips** on how you can do this, with posters and pre-winter checklists available on our **resources** page.

Support is available to schools who are concerned about maintaining good ventilation. This includes:

- specific ventilation advice from our COVID-19 ventilation team
- an operational funding grant that will become available to all schools in Term 2, to assist with additional heating costs during winter

- funding of urgent property improvements over $5,000 that are required to achieve good ventilation
- the free supply of a limited number of portable air cleaners and CO_2 monitors, being distributed to all schools in Term 2
- the supply of additional portable air cleaners where this is found to be the correct interim or supplementary solution
- the ability to purchase suitable portable air cleaners and CO_2 monitors from the Ministry's nominated suppliers at discounted pricing.

For ventilation advice and to access this support, please contact your Property Advisor or our COVID-19 ventilation team on ventilation.mailbox@education.govt.nz.

TILE 1 link to separate page: *Ventilation guidance*

TILE 2 link to separate page: *Assessing ventilation*

TILE 3 link to separate page: *Ventilation resources*

L2 page: Ventilation guidance

H1: Ventilation guidance

A space's ventilation will be influenced by how it was designed, how it is currently being used, and the outdoor conditions. Good ventilation will provide fresh, clean air while maintaining comfortable temperature and humidity levels for the people in the space.

Good ventilation helps reduce COVID-19 airborne transmission by quickly and consistently removing the old air and replacing it with fresh, clean air.

Indicators that a space may not be well-ventilated include a feeling of stuffiness, lingering smells and **elevated CO2 levels** created by the people in the room.

You can quickly improve the air quality in any space by:

- limiting more vigorous activities, or moving them outdoors or to a better ventilated space
- limiting the number of people, especially in smaller, confined spaces
- fully opening all windows and doors to flush the air in the room, and where it's an option to do so, briefly vacating the room at the same time.

<Quick links/jump links/contents/on this page>

- **Guidance for all naturally ventilated spaces**
- **Guidance for naturally ventilated spaces on cold, wet or windy days**
- **Guidance for ducted, mechanically ventilated spaces**
- **Guidance for using heat pumps and other heating systems**
- **Other supplementary solutions**

H2: Guidance for all naturally ventilated spaces

Most New Zealand schools and classrooms are naturally ventilated using windows that can be opened. Make the most of this by:

- Opening all windows and doors as much as possible, and whenever it is practical to do so. Do not wait for a space to get stuffy before opening windows and doors.
- Opening all windows before the school day starts and having them open whenever the room is vacated during the day.
- Opening windows and doors on the opposite sides of a room where possible to enable the cross flow of air, including any that connect to internal corridors or other circulation spaces.
- Turning on any fitted ceiling fans to increase air movement, but only when the windows are open to avoid recirculation of stale air.
- Taking regular short breaks (5-10 minutes each hour) where everyone exits the space with the windows and doors fully opened, to flush the space with fresh air.

Regularly check for any property issues that may need to be resolved, such as:

- ensuring any window that was originally designed to open, can still open
- unsticking windows which may have been fixed or painted shut
- replacing missing or broken window winders, hinges, catches or closers
- correcting any previous alterations which may be impeding good ventilation

Please contact your Ministry property advisor if you require additional ventilation support to address any property concerns.

H2: Guidance for naturally ventilated spaces on cold, wet or windy days

Bad weather can make it impractical to fully open windows and doors, but on cold days good ventilation can still be achieved with windows partially opened.

This is because air flow behaves differently at different temperatures – for example, the bigger the temperature difference between outside and inside, the more efficiently fresh outside air is drawn in through open windows.

For example:

- as a rule of thumb, it's possible to achieve good ventilation when partially opening all windows by 5cm
- having two windows open by 10cm each through the day provides the same benefit as running a large portable air cleaner, while also creating fresh air flow
- fully opening all windows and doors for three minutes every hour provides the same benefit as running a large portable air cleaner for 20 minutes, while also creating fresh air flow

On colder days, in addition to our general ventilation guidance, try to:

- Pre-heat spaces before the start of the school day. Having it warm inside improves the draw of fresh air through partially opened windows.

- Increase indoor heating during the day, if you need to, to offset the impact of having the windows partially open when it's cold outside.
- Where high level windows are fitted, open these first and wider than low level windows to reduce cold draughts in the room.
- Open lots of windows a little, rather than a few windows a lot. Close the door before you begin closing windows, reduce or close any windows directly facing the worst weather conditions (e.g. wind, rain or snow).
- On a wet day, try to keep wet clothes out of the classroom as bringing them in will make the classroom more difficult to heat.
- Consider adjusting the classroom layout to move students away from open windows, and other areas that may have cooler air or draughts.
- Consider relaxing uniform rules/dress codes and allowing warmer clothes to be worn, for people who are more sensitive to colder air and draughts.
- Continue to use refresh breaks, where all windows and doors are fully opened and preferably everyone exits the room for a few minutes each hour.
- Fine-tune your approach through the day as the weather changes. Fully opening windows still achieves the best ventilation, so increase your window openings if it warms up outside later in the day or whenever this can be done while maintaining a comfortable indoor temperature.

Continue **using your portable CO_2 monitors** to check if your ventilation is working effectively, in addition to the appropriate use of face coverings, physical distancing, good hygiene and other health measures.

An operational funding grant will become available to all schools in Term 2, to assist with additional heating costs during winter. More information about this will be made available in May.

H2: Guidance for ducted, mechanically ventilated spaces

Some schools are fitted with ducted mechanical ventilation systems that automatically source fresh air from the outside while also managing the temperature of the room. These are often referred to as HVAC or air conditioning systems. This doesn't include heat pumps, because they don't supply fresh air.

One way to identify if your space has a ducted mechanical ventilation system is to look for vents in the ceiling that bring in fresh air or extract old air.

Where ducted mechanical ventilation systems are fitted, the above advice for naturally ventilated spaces doesn't apply unless the system has specifically been designed to work in conjunction with windows and doors being open. If not, windows and doors should remain closed to allow the system to work as designed.

A well-configured ducted mechanical ventilation system will provide good ventilation while managing indoor temperatures. Make the most of this by:

- Ensuring the system is regularly checked, cleaned and maintained by an appropriately skilled technician.
- Having the system configured to come on at least two hours before and after the school day.

- Increasing the amount of fresh air brought in by the system and minimising the amount of old air it filters and recirculates.
- Continuing to **use your portable CO_2 monitors** to check if the system is working effectively.

Configuration and maintenance of ducted ventilation systems should only be done by appropriately skilled technicians. Technical guidance on this topic is available on our **resources** page.

H2: Guidance for using heat pumps and other heating systems

You can continue to use heat pumps to heat or cool spaces, even when windows and doors are open.

Heat pumps and most other heating systems only heat or cool recirculated air within the space. They do not bring in fresh air, so to achieve good ventilation they must be used alongside a means of providing fresh air.

When using heat pumps and other heating systems:

- pre-heat the space to a comfortable temperature before the school day to improve the draw of fresh air through partially opened windows
- increase indoor heating or cooling during the day, if you need to, to offset the impact of having the windows open
- resetting the temperature of the room to a comfortable level after it has been vacated and aired out, by briefly closing all windows and doors and running the system on its highest setting before re-occupying the room and re-opening windows.

Ahead of the colder months, your heat pump or heating system should be checked and serviced to make sure it is running at its best.

Using a heat pump with windows open will be less efficient and may incur some additional power costs. An operational funding grant will become available to all schools in Term 2, to assist with additional heating costs during winter. More information about this will be made available in May.

H2: Other supplementary solutions

H3: Portable air cleaners (purifiers)

Air cleaners are a supplementary solution that, in some cases, may be suitable to use in combination with good ventilation practices in spaces that are challenging to ventilate well.

Air cleaners can reduce COVID-19 airborne transmission by filtering and recirculating the air within a space. They do not replace ventilation in any circumstances, and do not reduce CO_2 levels.

It is more effective and beneficial to use a space's natural or mechanical ventilation to supply fresh air. For example:

- Good ventilation is consistent throughout a space, while the benefits from air cleaners can be localised to the immediate area they are placed in, especially for smaller units with a Clean Air Delivery Rate (CADR) under 400 m3/hour.
- Running a large (700 CADR) HEPA air cleaner on its highest setting will clean and recirculate the air in a space at the same rate as having two windows open by 10cm each through the day, but the windows will also create a flow of fresh air and reduce CO_2 levels.

- Running the same large air cleaner will clean and recirculate the air in a space in 20 minutes, whereas fully opening all windows and doors will fully refresh the air within three minutes.

Due to these factors, in some circumstances air cleaners are appropriate but they are not the primary or most effective method of reducing COVID-19 airborne transmission.

All state and state-integrated schools have been offered air cleaners to use at their discretion in spaces that may have a higher risk of airborne transmission such as some staff rooms, music rooms, high-use meeting and break-out rooms. Units are being distributed starting from March 2022.

Additional air cleaners are available for schools where ventilation cannot be improved through other immediate measures. Please contact your Ministry Property Advisor for assistance and consultation to determine if air cleaners are the right interim solution for your school.

As the Ministry will supply air cleaners to schools where they are required, there should be no need for schools to purchase their own, however some schools may elect to do so at their own cost.

In May 2022 we will advise arrangements for schools and other education sector entities to purchase air cleaners direct from the Ministry's selected supplier, at a discounted price.

If purchasing brands outside of these arrangements, our panel of experts recommend air cleaners that use H13-14 HEPA filters, have a Clean Air Delivery Rate (CADR) greater than 400 m3/hour, operate at less than 60dB and do not use any emerging technologies the emit particles into the air (for example ionisers, plasma discharge, ozone generators, photocatalytic oxidation, and hydrogen peroxide).

H3: Ceiling and other fixed fans

You can use ceiling fans and other fixed fans with windows and doors open, provided they do not interfere with the natural flow of air. Do not use fans when windows and doors are closed.

Well-designed and positioned ceiling fans can boost natural ventilation by up to [x]% when used in conjunction with opening windows and doors. If you are considering fitting new fans, please discuss with your Ministry Property Advisor first to ensure that they will improve existing ventilation.

H3: Portable fans

We recommend limiting use of portable fans as it can be difficult to determine whether they are assisting or interfering with air flow. Portable fans are also noisy and can be a safety hazard depending on how they are positioned in the room.

Most non-industrial portable fans do not produce sufficient air movement to offer a notable improvement to ventilation.

Do not use portable fans when the windows and doors are closed, including in spaces with ducted mechanical ventilation systems.

L2 page: Assessing ventilation

There are several ways to quickly assess whether a space is well ventilated. Your senses can give a good immediate indication – for example if a room feels stuffy or has lingering smells, it may not be well ventilated. You'll be able to verify this using your CO2 monitor.

If you can't resolve ventilation issues using our guidance, or you are concerned about ventilation in your school you can contact your Ministry Property Advisor or the Ministry's ventilation team on ventilation.mailbox@education.govt.nz.

H1: Carbon dioxide (CO_2) monitoring

Measuring CO_2 levels indicates how well-ventilated a space is when it is occupied. Elevated CO_2 levels means fresh air isn't flowing into a space quickly enough to meet the needs of the space's occupants. If sustained at elevated levels this can cause drowsiness and concentration issues for the people in the space.

Also, if the air in a space is not replaced quickly enough, pollutants and airborne particles including viruses stay in the air for longer. That means if anyone in the room is infectious with COVID-19, the risk of airborne transmission of the virus is increased.

To help schools assess CO_2 levels, we have distributed portable CO_2 monitors to all state and state-integrated schools, with more being distributed in May 2022. Some spaces already have fitted CO2 monitoring devices (via Internal Environment Monitors).

With winter approaching it is important to have a regular routine in place of checking CO_2 levels to gauge how well the supply of fresh air is being balanced with maintaining comfortable indoor temperatures. This is in addition to the appropriate use of face coverings, physical distancing, good hygiene and other health measures.

H2: How to set up your CO2 monitor

1. Follow the manufacturer's instructions in the box. To activate the device, fit the two supplied AA batteries. There is no on/off switch or other controls on the device that need to be set.
2. Prior to first use, sit the device outside for 15-30 minutes to let it calibrate to the outdoor fresh air CO_2 levels (approx. 420ppm).
3. Download the Aranet smartphone app from Google Play or the Apple App Store. The app allows you to connect to the device via Bluetooth to track readings over time and download the readings for up to seven days, in CSV format. Doing this will avoid you having to manually record the readings.
4. With the app there is the option to change the measurement interval to our recommended setting of every 2 minutes, and to adjust the warning levels to match our advice presented below.

H2: Using your CO2 monitor to perform spot checks

Spot checks provide an immediate indication of current CO_2 levels. If the levels are high, follow our guidance to try to lower it and also consider if you should monitor the space's CO_2 levels over a longer duration.

1. Take the device to each space and place it at around student head height, away from doors and windows, out of direct sunlight, and at least 1m away from the closest people. Note breathing directly into or over the device will cause it to report high CO_2 levels.

2. Leave the device in the room for at least 5 minutes before checking the CO_2 levels reported on the device's screen. If temperature readings are also required, extend this to 30 minutes to allow the device to report this accurately.
3. Repeat this process in a selection of spaces, or all spaces on a regular basis (e.g. fortnightly). Look for patterns and relationships between CO_2 levels, who is in the room, doing what, and with windows and doors open or closed.

H2: Using your CO2 monitor to gather a full day's readings

If you have a concern with how the space's ventilation is changing through the day, you can leave the device in the room for a longer period for it to automatically gather its readings.

1. Take the device into the space and place it at around student head height, away from doors and windows, out of direct sunlight, at least 1m away from the closest people and in a place where it will not be disturbed or moved.
2. At the end of the day, use the app to view and download the CO_2 readings. If downloading the data, ensure you only review the data linked to that space on that day. Take note of how CO_2 levels change based on who is in the room, doing what, with windows and doors open or closed at different times through the day.
3. When discussing your concerns with your Ministry Property Advisor or the Ministry's ventilation team on ventilation.mailbox@education.govt.nz, provide a copy of the downloaded data.

H2: Interpreting CO_2 levels

It's normal for CO_2 levels to fluctuate over the school day. This will happen depending on how many people are using the room, what activities they are doing, how the space's ventilation is performing and the outdoor conditions.

CO_2 levels generally build from the start of the day, drop at lunch time or during breaks, and build again during the afternoon. CO_2 levels decrease quickly when the space is vacated and/or when windows or doors are fully opened.

Short peaks in CO_2 levels shouldn't be a cause for concern but should be a prompt to consider what steps could be taken in response. If you have consistent and sustained elevated CO_2 levels not addressed by following our guidance, please speak to your property advisor.

SUSTAINED CO_2 LEVELS	WHAT TO DO
Less than 800 ppm	Your space is very well ventilated – continue with your current approach.
800-1250 ppm	Open all windows and doors as much as possible, and whenever it is practical to do so each school day while maintaining comfortable indoor temperatures.. Ensure all exterior windows are functional and can be opened as originally intended. This may require some maintenance or minor property improvements.

SUSTAINED CO_2 LEVELS	WHAT TO DO
	Consider briefly vacating the room, changing activity, or lowering the occupancy at times through the day to purge and refresh the air in the space.
1251-2000 ppm	Short peaks above 1250ppm throughout the day are common. If there are consistent and sustained elevations in CO_2 levels over 1250ppm over the school day, consider: • briefly vacating the room at regular intervals (e.g. 5 minutes each hour) with all windows and doors fully open, to purge and refresh the air in the space • lower the occupancy or the level of vigorous activity performed in the room • increase the use of other measures such as face coverings and physical distancing. If the elevated CO_2 levels continue, please speak to your property advisor.
Over 2000 ppm	Peaks of high CO_2 levels can also occur. If you have followed the above advice and continue to have sustained CO_2 levels over 2000ppm, please contact your property advisor.

H2: Purchasing additional CO_2 monitors

The portable CO_2 monitor the Ministry has selected is the **Aranet4 Home** device. We have distributed Aranet4 Home portable CO_2 monitors to all state and state-integrated schools, with more being distributed in May 2022.

If you would like to purchase additional devices, they can be sourced direct from our supplier Butler TechSense Ltd via the web site: https://co2sensor.co.nz/. A voucher code is available for schools and other education sector entities to order the devices at a discounted price.

If purchasing another CO_2 monitor brand, we recommend ensuring the device has a nondispersive infrared (NDIR) CO_2 sensor.

L3 page: Ventilation resources

H1: Downloadable resources – winter advice

- A4 Poster: Promoting air flow in schools
- A4 Poster: Maintaining good ventilation in winter (new)
- Checklist: Pre-winter ventilation checks (new)

H1: Downloadable resources – other

- Diagram: The Ministry's Ventilation Strategy (layered approach)
- A4 Poster: How different ventilation methods compare (new)
- A4 Poster: How to use a Samsung portable air cleaner
- A4 Poster: Where to position your portable air cleaner
- Technical Advice: Ducted mechanical ventilation systems

H1: Research and studies

H2: Classroom ventilation study (January 2022)

The results from our study with NIWA to understand more about classroom ventilation further verified our COVID-19 classroom ventilation strategy.

The study involved looking at ventilation levels in typical classrooms being used as they normally are during the day. This was done by monitoring the amount of CO2, which indicates how much fresh air flow there is, in 18 different classrooms across three schools.

The study verified that good ventilation can be achieved in most naturally ventilated classrooms by opening windows and doors. The study highlighted the added benefits of opening windows and doors on different sides of the room, of introducing short breaks to periodically purge the room of stale air, and of supplementary assisted natural ventilation systems (e.g. extract/exhaust fans).

It also identified other areas for further research, including classroom ventilation in cold weather, and the effective use of portable air cleaners and other supplementary measures.

- Paper: NIWA rapid study

[Placeholder here for subsequent study, 2x literature reviews, Nanogirl – add as/when available]

H1: Other online resources

Ministry of Education property advisors — education.govt.nz

Te Mahau – Advice for schools and kura

Unite against COVID-19 — covid19.govt.nz

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

MINUTES

Ventilation Technical Advisory Group (VTAG)

Date:	Wednesday 27 April 2022		
Time:	1.00pm – 2.00pm		
Venue:	MS Teams		
Members:	Perry Davy (Chair)	Mikael Boulic	Mark Jermy
	Ian Longley	Manfred Plagmann	
Attendees:	Scott MacKenzie	Renelle Gronert	Vicky Evans
	Olivia Leckner	Ackley Aniebietabasi	Secretariat: Anastasia King
	Lexi Sutherland	Jason Chen	
Apologies:	Robyn Phipps	David Fullbrook	Jeremy Tuohy
	Brooke Hollingshead	Guy Coulson	

Minutes:

Apologies received from Robyn, Brooke, Mark, and Ackley.

Minutes from 13 April meeting read and approved.

Topic	Discussion
1. Actions/ Decisions (Perry Davy - Chair)	Out of scope
2. Term 2 Guidance – Final Review	

	Topic	Description	Priority
1.	**Describing temperature differential**	How we have described 'air flow behaves differently at different temperatures' – we have struggled to concisely describe this without being too technical, or too simple.	Low
	VTAG Comment:	*Members agree with the current wording.*	
2.	**Dilution vs spread**	For any solution that moves around air in the room (e.g., heat pumps, fans), be it with or without fresh air being introduced, what is our position between the potentially competing views on this potentially spreading infected particles around the room increasing infection risk, versus this diluting concentrations of particles and decreasing infection risk?	High
	VTAG Comment:	*The potential benefit of dilution exceeds the potential of spread.*	
3.	**Ceiling fans**	As an extension of (2), our advice for use of ceiling fans to assist natural ventilation noting results of the most recent studies (Ackley/Ian/Jason/Lexi can present/discuss this data.	Medium
	VTAG Comment:	*Well-designed and positioned fixed fans that bring in fresh air or push out the existing air can boost natural ventilation in conjunction, or as an alternative to with opening windows and doors. If you are considering fitting extract or supply fans, please discuss with your Ministry Property Advisor first to ensure that they will improve existing ventilation.*	
4.	**Colder days 'rules of thumb'**	Is VTAG comfortable with how we have presented this 'simplified' guidance (i.e., the 5cm partially opening windows, 10cm comparator to PACS, 3 minutes to flush a room).	High
	VTAG Comment:	*Change wording to reflect 3-5 minutes to flush a room.*	
5.	**Other colder days advice**	As an extension of (4), reviewing the new bullets added/refined/discussed in the first pass of VTAG review (preheating, offset heating, wet clothes out, sensitive people).	Low
	VTAG Comment:	*Members are comfortable with the advice as presented.*	
6.	**Air cleaner comparators**	Similar to (4), how we best explain how an air cleaner compares to fresh air ventilation – yes, we know apples to oranges, but not in the eyes of the public.	High
	VTAG Comment:	*Members agreed that Scott to work with Ian to review wording.*	
7.	**Air cleaner specs**	Confirm comfortable with short-form description of 'panel of experts' recommendation for spec (aligns to recent RFP at a summary level).	Medium
	VTAG Comment:	*Tidy up wording around reference to emerging technologies and particle emissions.*	

4. Future agenda items	Out of scope

Out of scope

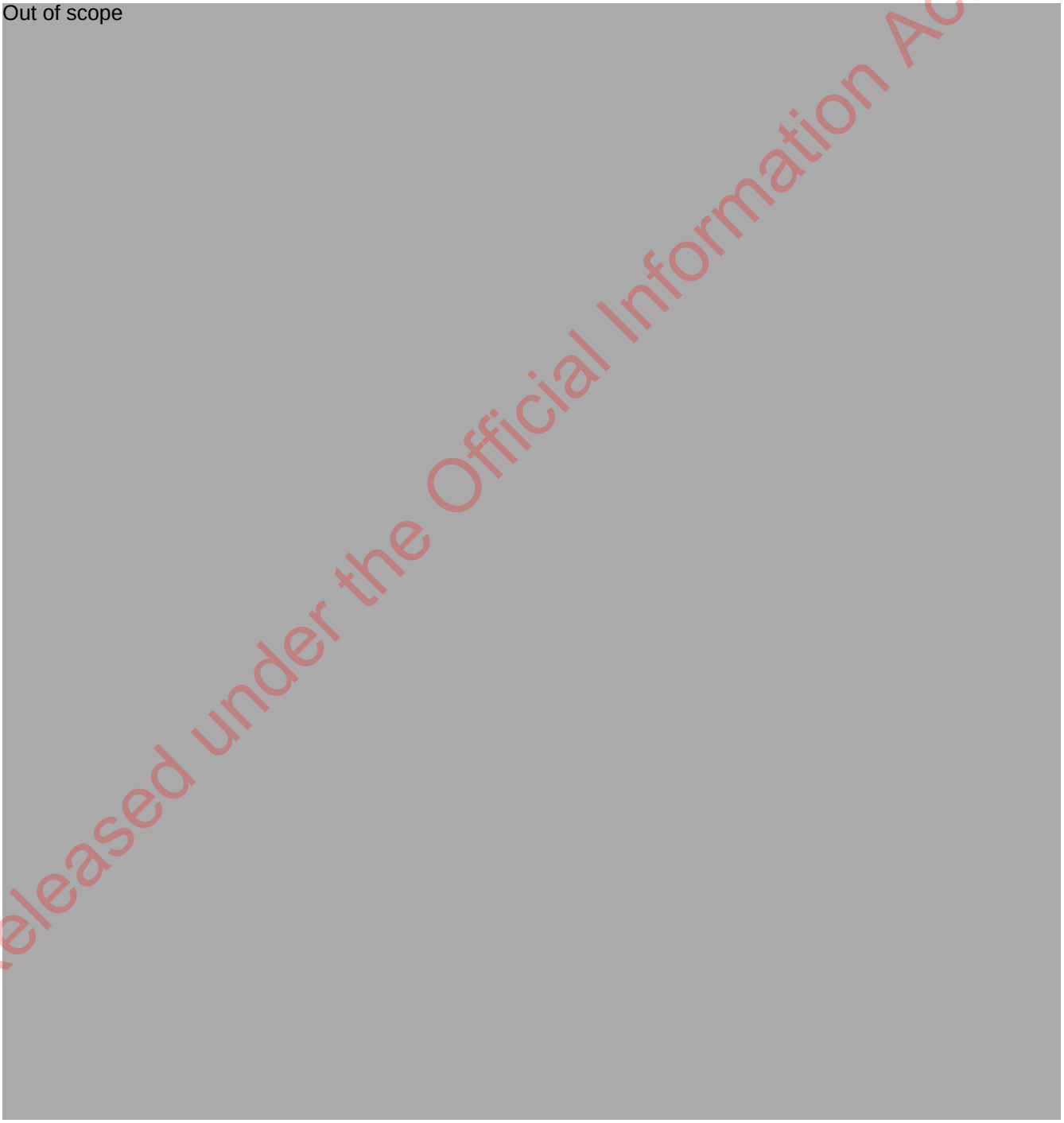
Action Log

Open items:

Action #	Action description	Due	Responsible
VTAG 0016	Renelle to discuss ventilation commentary in schools by Prof Baker with Robyn Phipps to understand his concerns.	30/04/22	Renelle

Recently closed items

Out of scope



Out of scope

Document 7: Email to VTAG members requesting feedback on advice for teachers in a classroom

Sofia Craig

From:	Scott MacKenzie
Sent:	Wednesday, 13 July 2022 6:34 pm
To:	Robyn Phipps; Ian Longley; Jeremy Tuohy; Manfred Plagmann; Mark Jermy; Mikael Boulic; Perry Davy
Cc:	Tracey.jury@sweeneyvesty.com; Jason Chen; Euan Russell; Renelle Gronert; Guy Coulson; Ackley Aniebietabasi; Michelle Patience
Subject:	RE: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)
Attachments:	Promoting air flow in schools_FINAL_1.pdf; Six tips for good ventilation in winter (1).pdf
Importance:	High

Thanks all for the discussion today.

Late today we had it confirmed that we will be providing some direct information into classrooms to help remind teachers on the pertinent use of masking and ventilation, for the start of Term 3. Form TBC but think graphical, not many words, maybe an A4 poster that can go on the door as you head in. Half masking, half ventilation but up to wider team if other measures go on it too. I was hoping to defer this into next week's VTAG but round-robin feedback ASAP appreciated (sorry).

Our challenge is to pull our advice down to what we believe are the three more pertinent ventilation points for a TEACHER (and other occupants of the room) to be mindful of. Attached are some current material, and we need to focus on what the room occupants can control or moderate – for example, often teachers cannot control pre-heat. We will still cover the full set of advice through other mediums. We want this poster to be assertive i.e. 'just tell us what to do' advice that anyone can get – including young students.

My starter for ten (sticking with the sneak, heat and reboot theme yesterday with some tweaks), and these are the CONCEPTS not the final wording:

1. **Windows:** Open it by a little when you can't open it a lot, and close it when you have to. Sneak them open whenever you can. Don't default to full closed just because. If you can, fully open.

2. **Heating:** Keep warm, and don't make it cold just to make it fresh. If it's cold, get it to 18 degrees before you start sneaking windows open. Preheating, warm clothing, ongoing heating all fit within this. Nothing we do should result in cold classrooms or students.

3. **Refresh breaks:** Reboot the room at least 4 times a day. A few minutes with everything wide open will blast out the bugs but won't blast out the heat. Airing out the room during breaks also fits into this. '4 times' is invented to keep it simple (i.e. our data suggests a 930am break would do the most good – but easier just to have this happen regularly; once an hour to impactful on learning).

Trying to be very direct and nuanced in this – i.e. 'three ventilation tips for classrooms that will help reduce COVID-19 transmission this winter season'. Hence aiming for an easy catch-phrase that can be graphically represented like **sneak, heat and reboot**; or **keep it fresh, keep it warm and REBOOT.**

But the key questions – do VTAG members agree these are the three themes we should be emphasising with the occupants in direct control of the classroom through the school day? Are we overlooking other parts of our ventilation guidance that are MORE beneficial to highlight than these?

Note I've left CO2 and air cleaners out as these are not a tool in all spaces. We might following this have a response-style poster – i.e. one you stick on the door of a room we believe has higher risk due to activities or property factors

that point to other more specific mitigations (i.e. This room has an air cleaner in it for a reason – turn it on FULL all day!).

All ideas and feedback welcomed!

Thanks again,

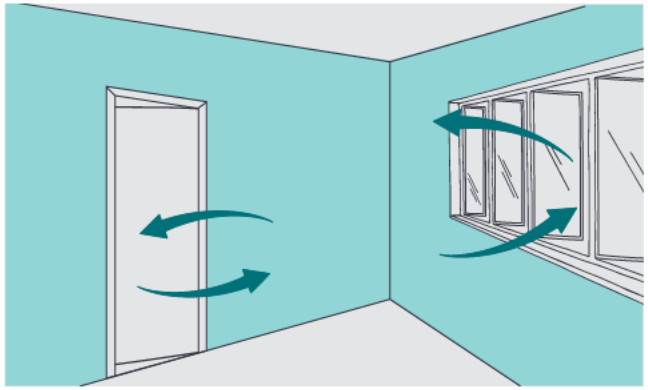
Scott MacKenzie
Programme Director – Ventilation (COVID-19)

TE TĀHUHU O TE MĀTAURANGA
MINISTRY OF EDUCATION

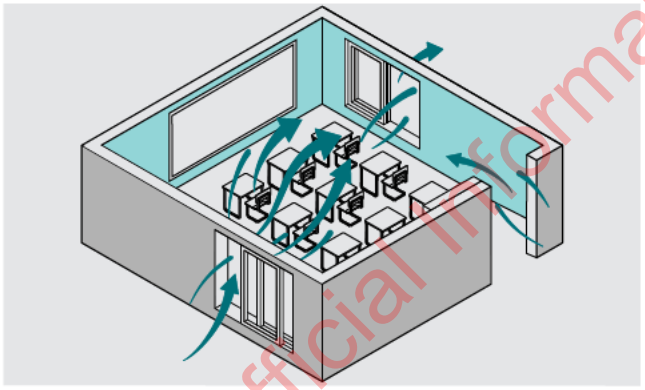
Document 7a: Document for VTAG members requesting feedback on advice for teachers in a classroom (attachment to email)

Promoting air flow in our schools

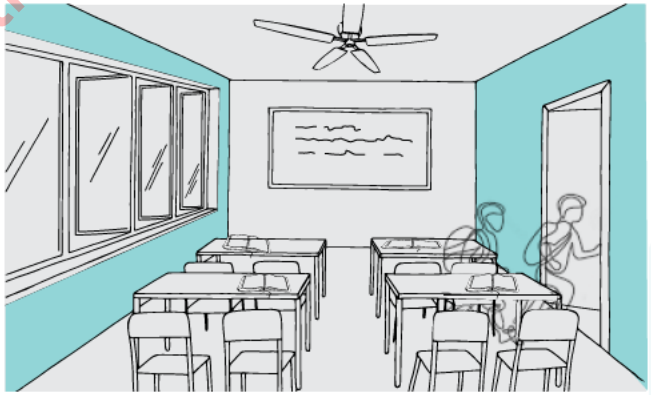
Fully open windows and doors as much as practical. Every little bit helps.

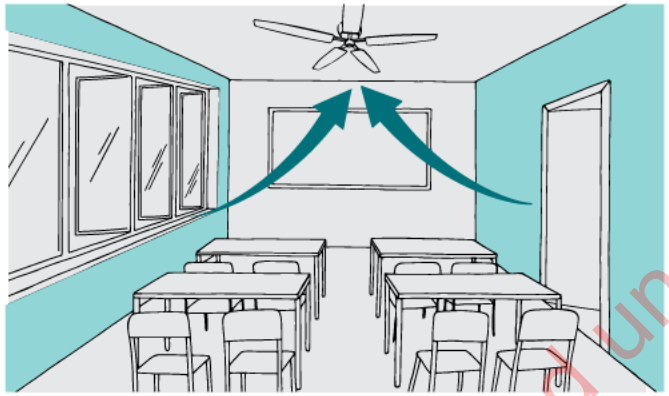


Open windows and doors on multiple sides of the room, if possible.

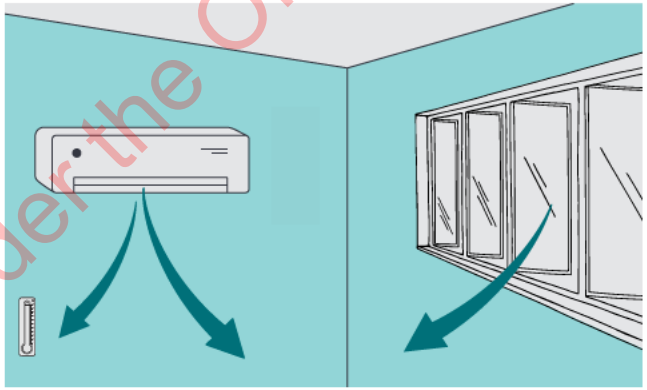


Have regular refresh breaks, where everyone exits the room while leaving windows and doors fully open to flush the air in the room.





Maximise air movement by turning on any fitted ceiling or extract fans, in addition to opening windows and doors.



For thermal comfort, use heating and air conditioning systems – even when windows and doors are open.

If it's too hot, cold, noisy or disruptive to have windows and doors open all the time, open them as much and as long as practical in addition to having refresh breaks.

Please note schools with ducted, mechanical ventilation systems that bring in fresh air should keep windows and doors closed, unless the system has been designed otherwise.

If you have questions about ventilation contact:
ventilation.mailbox@education.govt.nz

Document 7b: Document for VTAG members requesting feedback on advice for teachers in a classroom (attachment to email)

Six tips for good ventilation in winter

TE TĀHUHU O TE MĀTAURANGA
MINISTRY OF EDUCATION

Good ventilation helps us slow the spread of COVID-19. Keep classrooms comfortable on cold, wet and windy days by balancing fresh air flow and temperature.
To do this you can:

Partially open windows

When it's cold outside and warm inside

Cold outside air flows into warm rooms more efficiently, so partially open windows (5cm) can create good air flow.

Heat the room

Before the start of the school day

Keep heating throughout the day as needed to stay warm with windows partially open.

Keep bad weather out

By closing any windows you need to

Leave the others open to create air flow.

Open lots of windows a little

Rather than opening a few windows a lot

Open high windows first and wider than lower windows to reduce cold draughts.

Take refresh breaks

For 3-5 minutes each hour

By fully opening all windows and doors to let fresh air in, and ideally having everyone exit the room.

Use your CO_2 monitors

To check if the ventilation is working effectively

Then adjust you approach as needed or contact us for more support.

Fully open windows and doors to allow air flow anytime you can, and follow other health measures including good hygiene, physical distancing and the use of face coverings.

If you have questions about ventilation contact:
ventilation.mailbox@education.govt.nz

Document 8: Email chain from VTAG members providing feedback re advice for teachers in a classroom

Sofia Craig

From: Scott MacKenzie
Sent: Thursday, 14 July 2022 6:40 am
To: Michelle Patience
Cc: Tracey Jury; Helen Hurst
Subject: FW: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)

Importance: High

Morena, follow up thought.

If the purpose of the poster is teachers and students in classrooms, and you ask 'what is most important for and controllable by those in the room', you come up with a third – hygiene (+ masks, + ventilation). Hygiene is/could be a combo of staying away if sick, not getting in people's faces, coughing into your arm etc. When you watch in a classroom this is very prominent (kids will be kids) and stands out as a high probably of illness transmission. If so, a poster would roll up to three points:

1. Keep it clean/hygiene
2. Mask it
3. Air it out while keeping warm

Think it's worth discussing this with the wider team as if you come up to that level you'd reduce the below into a sentence of 'open windows as much as you can while staying warm, and air out the room at least 4 times a day'.

Scott MacKenzie
Programme Director – Ventilation (COVID-19)

From: Scott MacKenzie
Sent: Wednesday, 13 July 2022 6:34 pm
To: Robyn Phipps <robyn.phipps@vuw.ac.nz>; Ian Longley <Ian.Longley@niwa.co.nz>; Jeremy Tuohy <Jeremy.Tuohy@health.govt.nz>; Manfred Plagmann <Manfred.Plagmann@branz.co.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Mikael Boulic <m.boulic@massey.ac.nz>; Perry Davy <p.davy@gns.cri.nz>
Cc: Tracey.jury@sweeneyvesty.com; Jason Chen <Jason.Chen@education.govt.nz>; Euan Russell <Euan.Russell@health.govt.nz>; Renelle Gronert <Renelle.Gronert@education.govt.nz>; Guy Coulson <guy.coulson@niwa.co.nz>; Ackley Aniebietabasi <Ackley.Aniebietabasi@education.govt.nz>; Michelle Patience <Michelle.Patience@education.govt.nz>
Subject: RE: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)
Importance: High

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heat. We will still cover the full set of advice through other mediums. We want this poster to be assertive i.e. 'just tell us what to do' advice that anyone can get – including young students.

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But the key questions – do VTAG members agree these are the three themes we should be emphasising with the occupants in direct control of the classroom through the school day? Are we overlooking other parts of our ventilation guidance that are MORE beneficial to highlight than these?

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All ideas and feedback welcomed!

Thanks again,

Scott MacKenzie
Programme Director – Ventilation (COVID-19)

Sofia Craig

From: Ian Longley <Ian.Longley@niwa.co.nz>
Sent: Thursday, 14 July 2022 1:13 pm
To: Scott MacKenzie; Robyn Phipps; Jeremy.Tuohy; Manfred Plagmann; Mark Jermy; Boulic, Mikael; Perry Davy
Cc: Tracey.jury@sweeneyvesty.com; Jason Chen; Euan Russell; Renelle Gronert; Guy Coulson; Ackley Aniebietabasi; Michelle Patience
Subject: RE: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)
Attachments: flow chart for teachers 14Jul2022.pptx

Categories: Read

Hi Scott and team

Firstly, in brief, we are running detailed experiments at 2 schools during these school holidays with the main focus on how to ventilate when outdoor air is polluted.
The good news is our results so far completely corroborate everything we've been saying thus far – no nasty surprises!

So, to Scott's question do VTAG members agree these are the three themes we should be emphasising with the occupants in direct control of the classroom through the school day? Are we overlooking other parts of our ventilation guidance that are MORE beneficial to highlight than these? My answer is basically – I totally agree with the three themes.

What I would add is a little nuance…

- Pre-heating is very effective, much more so than your intuition tells you. This basically "charges the battery" storing heat in the building that is then gradually released later in the day effectively compensating for heat losses when the windows are open. Teachers need to alert principal if this is NOT happening (or heating is under-powered). We need to get school staff to overcome their faulty intuition and trust in the physics (prove it to themselves).
- Opening the multiple windows a little is, in my view, the single most effective measure. Ideally done after an hour of pre-heating (not earlier as it undermines the heating). Number one message should be room occupied = windows opened.
- In my view "purging" is physically effective, but more difficult to enforce sustainably. It is also only really needed if a "steady state" solution cannot be found (but that takes monitoring to assess). This should be tried, and some teachers will adopt it as a habit, but I suspect many won't. It is unlikely to be a long-term solution (and this might be where the PACs come in – see below).

More generally, messaging should counter the intuitive point of view that classrooms are harder to ventilate in winter (which is something I may have said in the past). My view now is that this statement is misleading and maybe not even be true. A well-heated classroom is effectively self-ventilating if set up correctly – the heating drives the ventilation rather than competing with it.

Finally, it pains me (but not surprises) to hear about the PACs. We have a high risk of a very poor return on investment and their conversion into e-waste, but this is NOT inevitable. I'd like to discuss a PAC rescue plan to make sure we're getting some real value out of them.

Finally, attached a very quick possible flow chart aimed at teachers for your consideration.

Ian

From: Scott MacKenzie <Scott.MacKenzie@education.govt.nz>
Sent: Wednesday, 13 July 2022 6:34 PM

To: Robyn Phipps <robyn.phipps@vuw.ac.nz>; Ian Longley <Ian.Longley@niwa.co.nz>; Jeremy Tuohy <Jeremy.Tuohy@health.govt.nz>; Manfred Plagmann <Manfred.Plagmann@branz.co.nz>; Mark Jermy <mark.jermy@canterbury.ac.nz>; Boulic, Mikael <m.boulic@massey.ac.nz>; Perry Davy <p.davy@gns.cri.nz>
Cc: Tracey.jury@sweeneyvesty.com; Jason Chen <Jason.Chen@education.govt.nz>; Euan Russell <Euan.Russell@health.govt.nz>; Renelle Gronert <Renelle.Gronert@education.govt.nz>; Guy Coulson <Guy.Coulson@niwa.co.nz>; Ackley Aniebietabasi <ackley.aniebietabasi@education.govt.nz>; Michelle Patience <Michelle.Patience@education.govt.nz>
Subject: RE: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)
Importance: High

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All ideas and feedback welcomed!

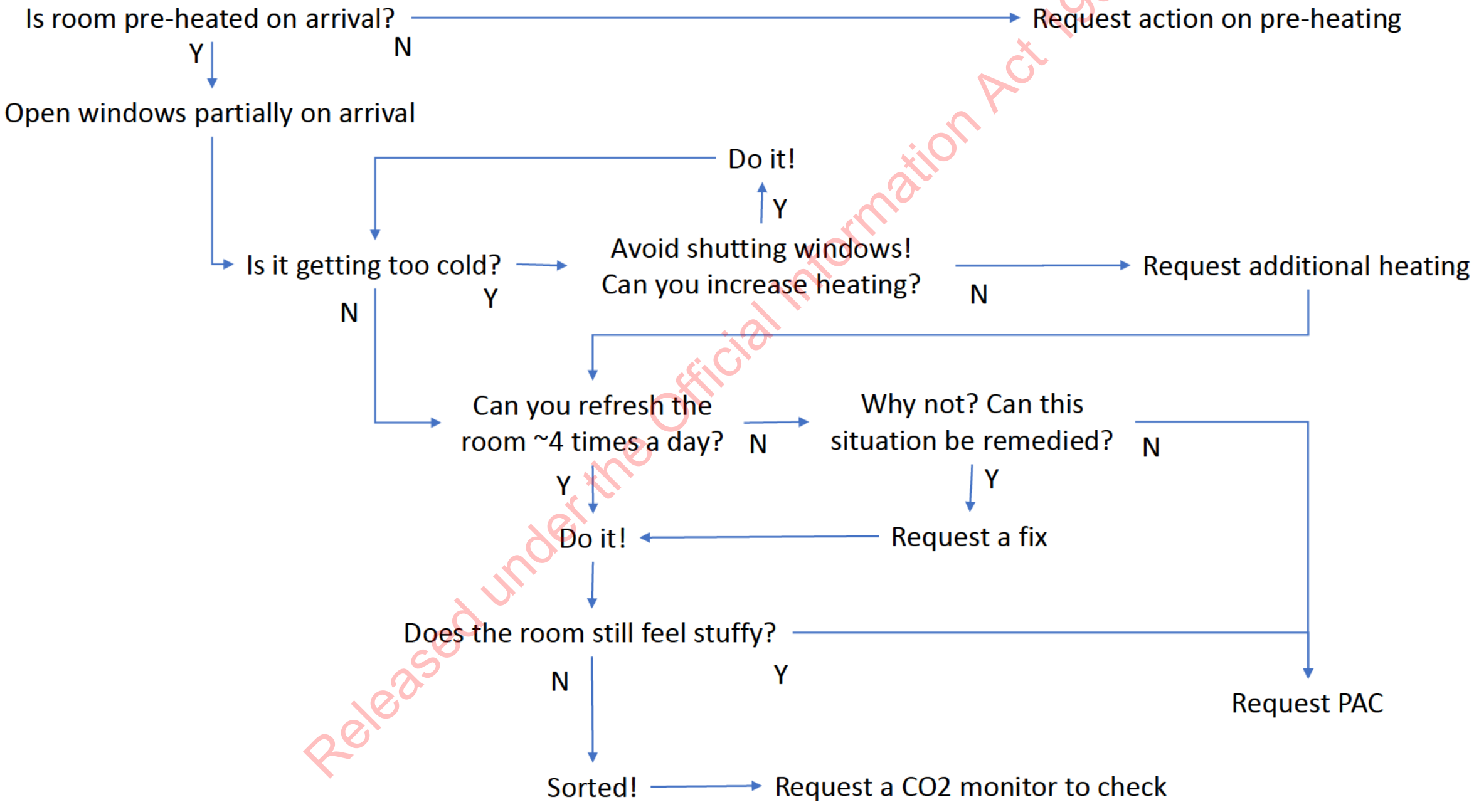
Thanks again,

Scott MacKenzie
Programme Director – Ventilation (COVID-19)

Dr Ian Longley
Principal Scientist - Air Quality
Programme Leader - Atmospheric Environment, Health and Society
9(2)(a)
National Institute of Water & Atmospheric Research Ltd (NIWA)
41 Market Place Viaduct Harbour Auckland New Zealand
Connect with NIWA: niwa.co.nz Facebook LinkedIn Twitter Instagram

Document 8a: Document from VTAG members providing feedback re advice for teachers in a classroom

For teachers in rooms without CO2 monitors or PACs



Document 8b: Email chain from VTAG members (continued) providing feedback re advice for teachers in a classroom

Sofia Craig

From: Robyn Phipps <robyn.phipps@vuw.ac.nz>
Sent: Friday, 15 July 2022 11:01 am
To: Mikael Boulic; Mark Jermy; Renelle Gronert; Ian Longley; Scott MacKenzie; Jeremy.Tuohy; Manfred Plagmann; Perry Davy
Cc: Tracey.jury@sweeneyvesty.com; Jason Chen; Euan Russell; Guy Coulson; Ackley Aniebietabasi; Michelle Patience
Subject: Re: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)

Categories: Read

Great comments everyone.

I suggest replacing SNEAK with OPEN. It's a clearer direction and doesn't have the undertone of being devious.

Regards

Robyn

From: Mikael Boulic <M.Boulic@massey.ac.nz>
Date: Friday, 15 July 2022 at 9:59 AM
To: Mark Jermy <mark.jermy@canterbury.ac.nz>, Renelle Gronert <Renelle.Gronert@education.govt.nz>, Ian Longley <Ian.Longley@niwa.co.nz>, Scott MacKenzie <scott.mackenzie@education.govt.nz>, Robyn Phipps <robyn.phipps@vuw.ac.nz>, Jeremy Tuohy <Jeremy.Tuohy@health.govt.nz>, Manfred Plagmann <Manfred.Plagmann@branz.co.nz>, Perry Davy <p.davy@gns.cri.nz>
Cc: Tracey.jury@sweeneyvesty.com <Tracey.jury@sweeneyvesty.com>, Jason Chen <Jason.Chen@education.govt.nz>, Euan Russell <Euan.Russell@health.govt.nz>, Guy Coulson <guy.coulson@niwa.co.nz>, Ackley Aniebietabasi <ackley.aniebietabasi@education.govt.nz>, Michelle Patience <Michelle.Patience@education.govt.nz>
Subject: RE: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)

I'm also supporting the idea of simple/short 3 points.
We could also add QR codes to videos illustrating each of the 3 points.
When QR codes are there, people are tempted to scan them, much more efficient than a website link

Mik

From: Mark Jermy <mark.jermy@canterbury.ac.nz>
Sent: Friday, 15 July 2022 9:25 AM
To: Renelle Gronert <Renelle.Gronert@education.govt.nz>; Ian Longley <Ian.Longley@niwa.co.nz>; Mikael Boulic <M.Boulic@massey.ac.nz>; Scott MacKenzie <Scott.MacKenzie@education.govt.nz>; Robyn Phipps <robyn.phipps@vuw.ac.nz>; Jeremy.Tuohy <Jeremy.Tuohy@health.govt.nz>; Manfred Plagmann <Manfred.Plagmann@branz.co.nz>; Perry Davy <p.davy@gns.cri.nz>
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Subject: Re: VTAG Advice: Most pertinent advice for teachers in a classroom (urgent)

Great ideas- I added a few things to the document on Teams to capture this.