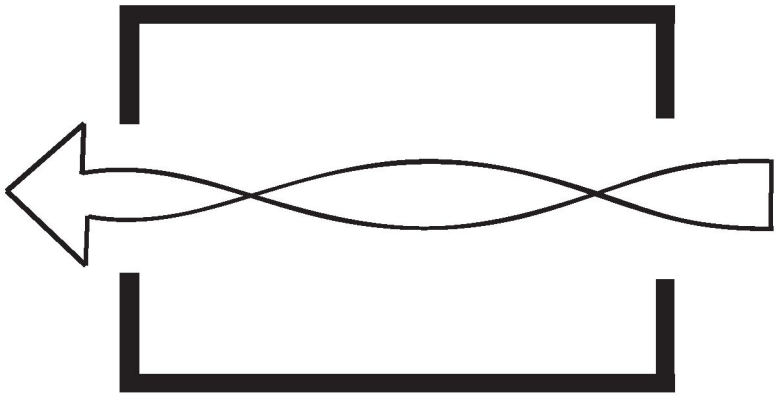
VENTING ABOUT VENTILATION

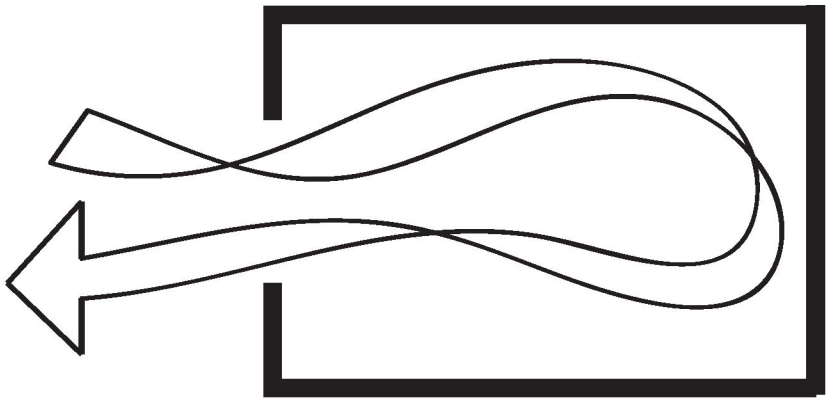
Kelli Kimura
Yang Lv
Hanzhao Huang

What is natural ventilation?

- Cooling → Save money on electricity
- Temporal comfort
- Air quality comfort



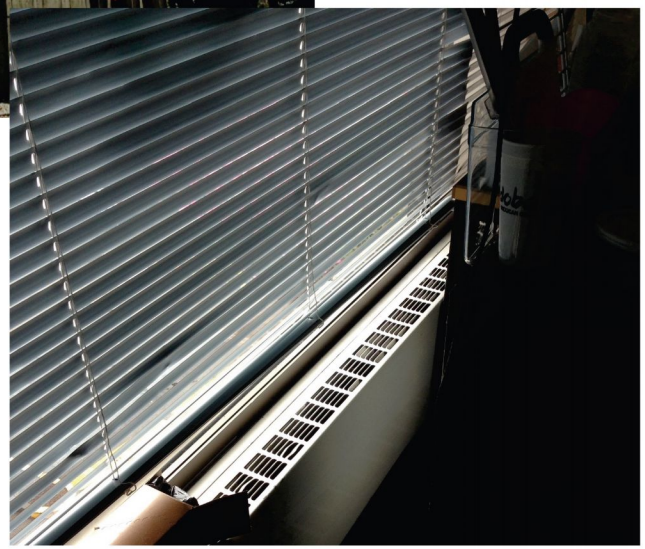
Cross Ventilation



Single Sided Ventilation

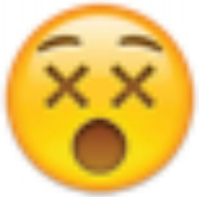
Natural Ventilation and Barnhart

Barnhart Exterior



Dorm room heater

"Sticky air" → How can we improve this?



PROBLEM: Residents in older dorms can not turn off heat = heat loss and higher electricity costs

Goals

To figure out:

- Is natural ventilation effective enough to meet the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard?
- Is opening windows necessary to meet the standard?
- What is the movement of air?

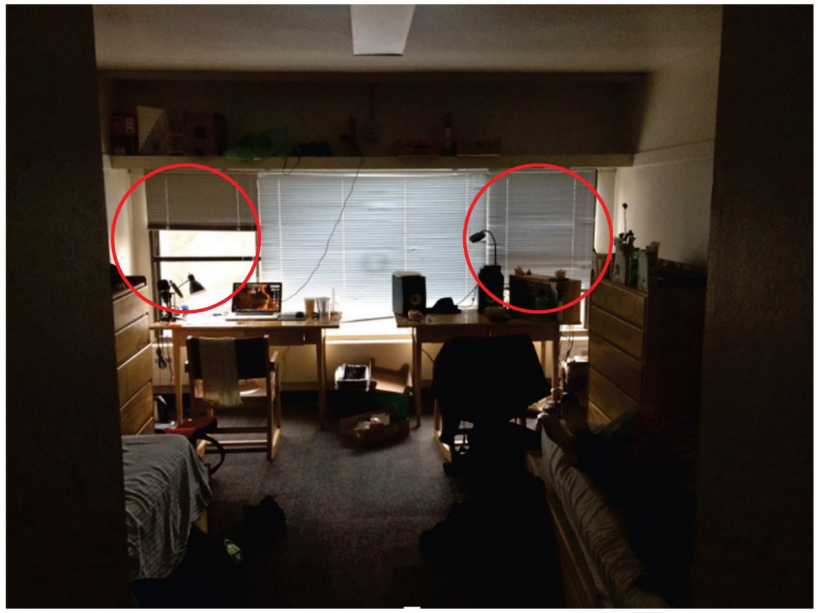
Hypothesis

Natural ventilation through a Barnhart dorm room window will exceed the ASHRAE standard 62.1-2013 of 5 cfm/person

When a Barnhart dormitory is naturally ventilated bubbles blown near a window will be able to reach the center of the room.

Background

- 1 North, 1 South wing room
- Same floor
- Same conditions/time of day



Typical Room w/ 2 Operable Windows

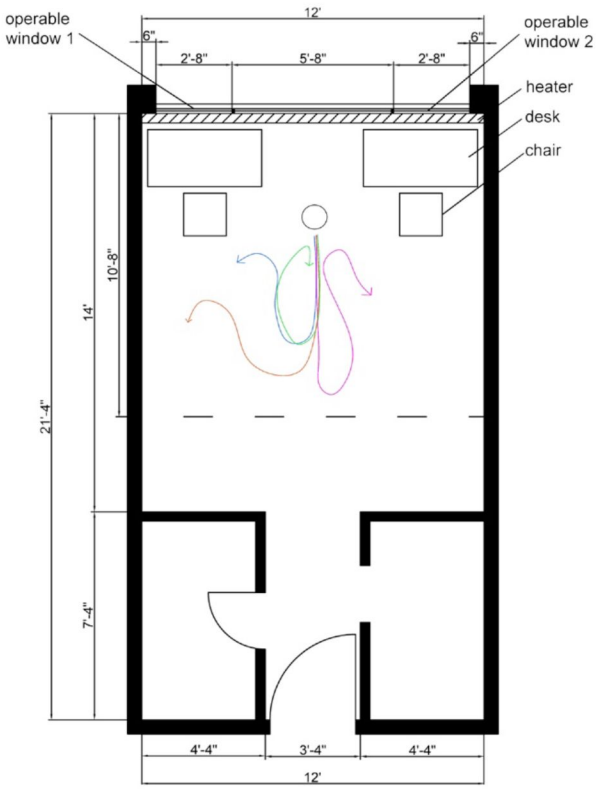
Typical sliding window

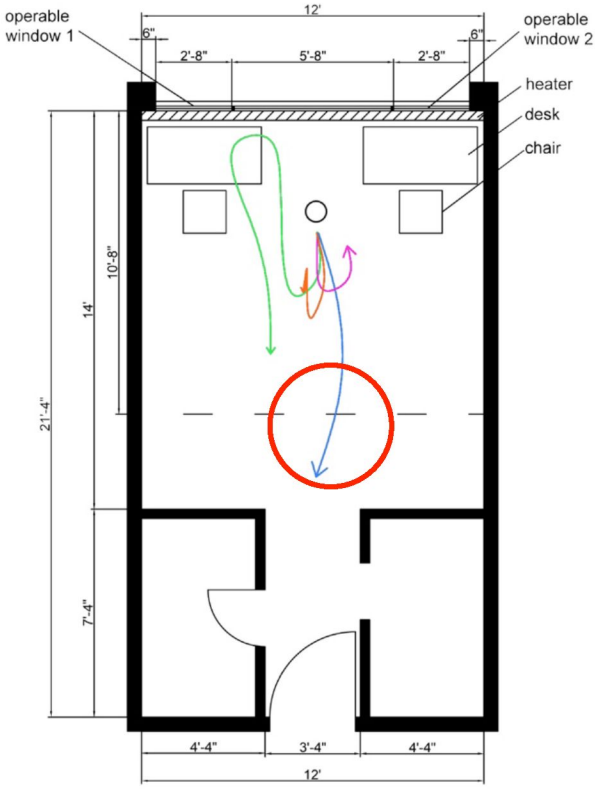
Part 1: Bubble Mapping

ROOM 1: WINDOWS FULLY OPEN

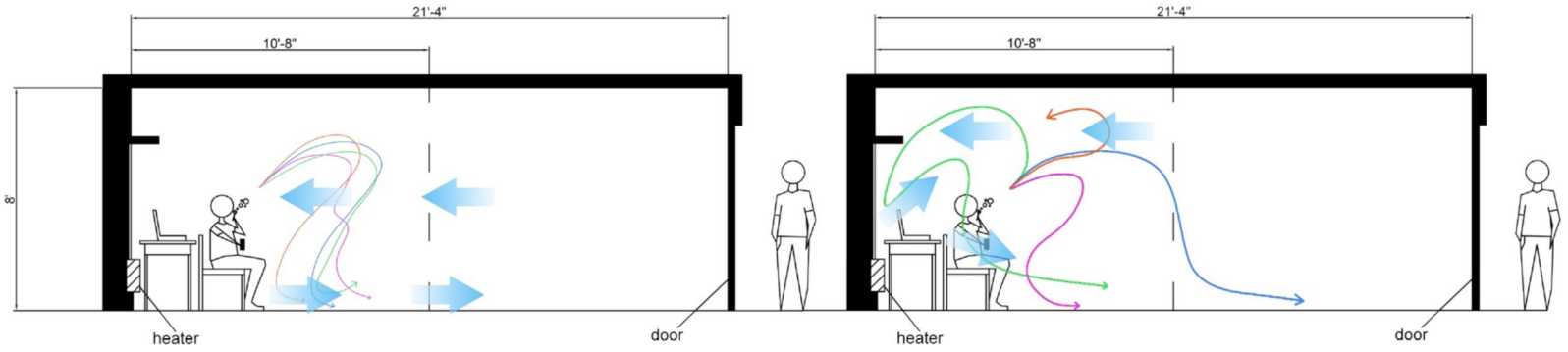
ROOM 2: WINDOWS FULLY OPEN

Plans

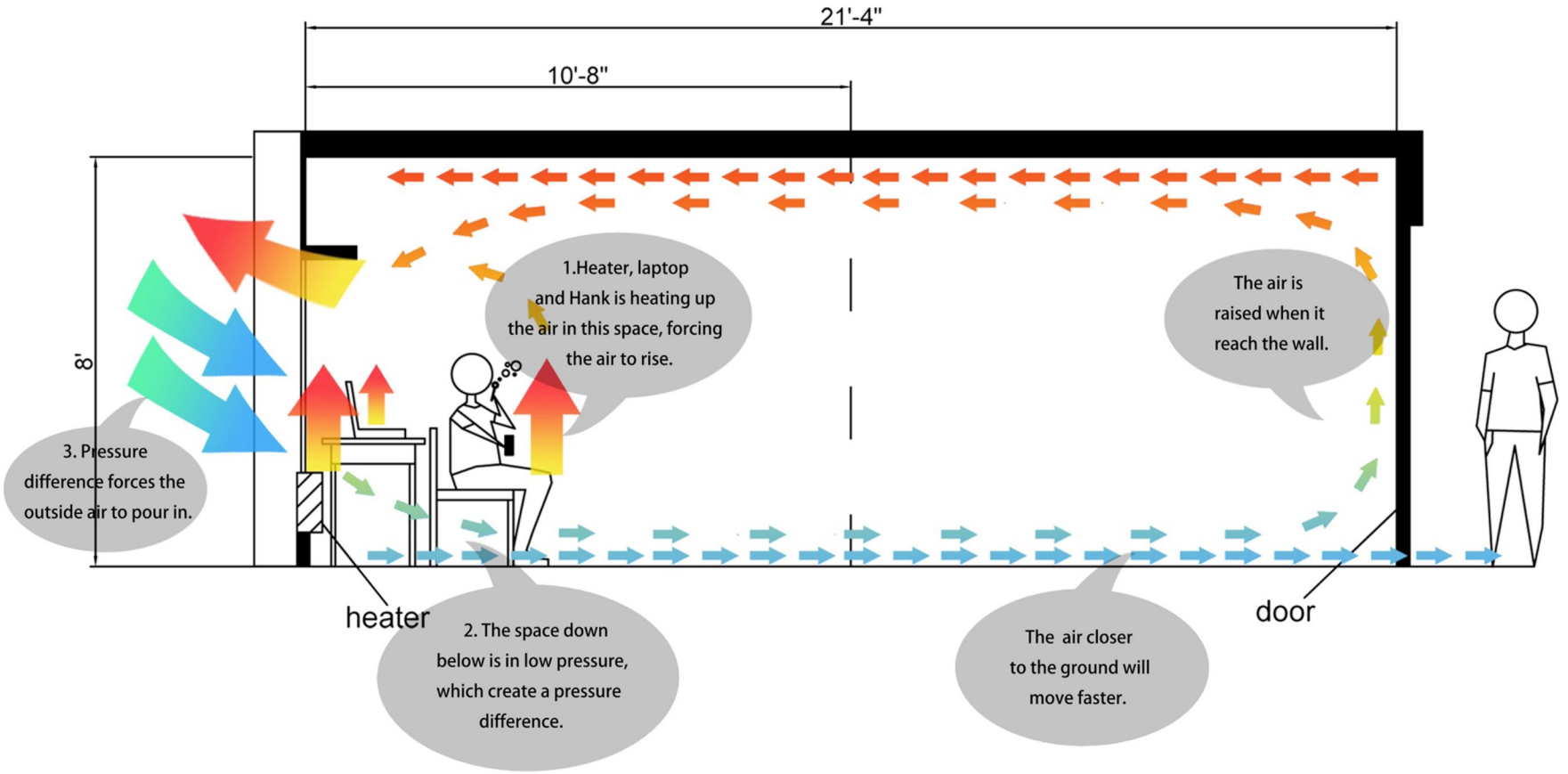




Sections



Summary of Observations



Findings

Hypothesis: When a Barnhart dormitory is naturally ventilated bubbles blown near a window will be able to reach the center of the room.

- Single Sided Ventilation = circular air movement
- Bubbles reach center of West facing room

Part 2: Measuring CO_2

Why is it important?

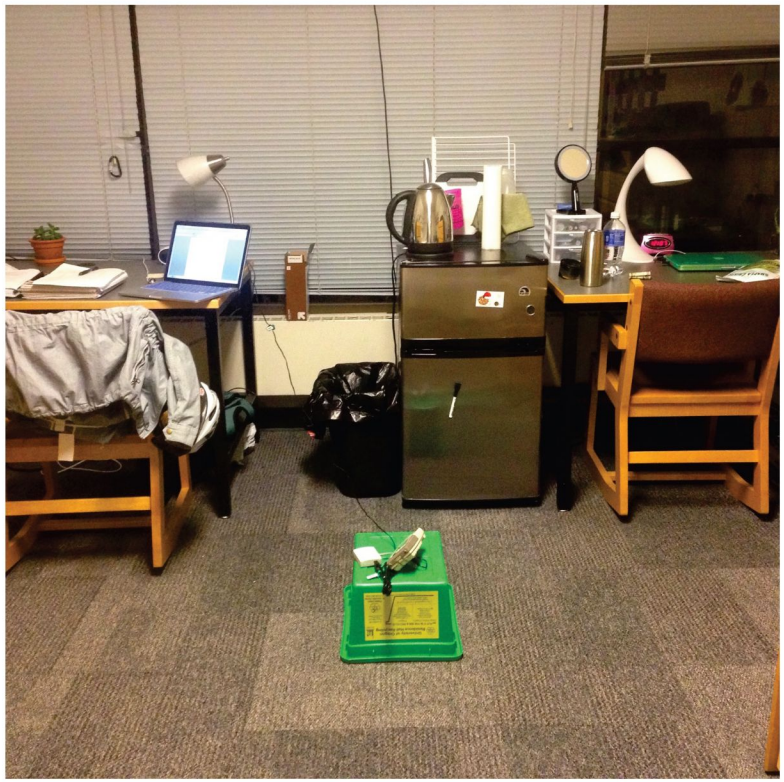
- Humans exhale it → indication of occupancy
- CO2 levels out/inside – CO2 levels out/inside= CO2 differential
- Differential (ppm) corresponds to ventilation rate per person value

Table 1: Ventilation and Resultant CO_2 Concentrations. Source: (Prill 2000)

Outdoor Air-Flow Rate or Ventilation Rate (cfm/person)	CO_2 Differential (ppm)
20 (or less)	500
15 (or less)	650
10 (or less)	1050
5 (or less)	2050

Note: *The CO_2 values in this table are approximate, and based on a constant number of sedentary adult occupants, a constant ventilation rate, an outdoor air CO_2 concentration of about 380 ppm, and good mixing of the indoor room.*

Equipment



Setup in room

CO2 Meter

HOBO Datalogger

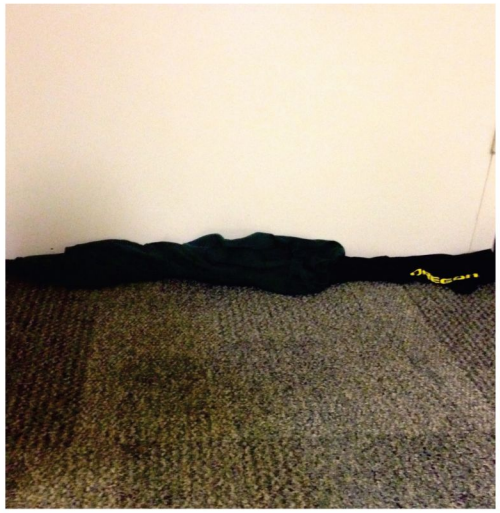
http://www.onsetcomp.com/products/data-loggers/u12-012
http://www.onsetcomp.com/products/sensors/tel-7001

Testing

CONDITIONS

1. Existing Condition = Windows not open, vent and door not sealed
2. Control Condition = Windows not open, vent and door sealed
3. Windows cracked 3 inches, vent and door sealed
4. Windows open 100% for one hour twice and day, vent and door sealed

Sealed Bathroom Vent



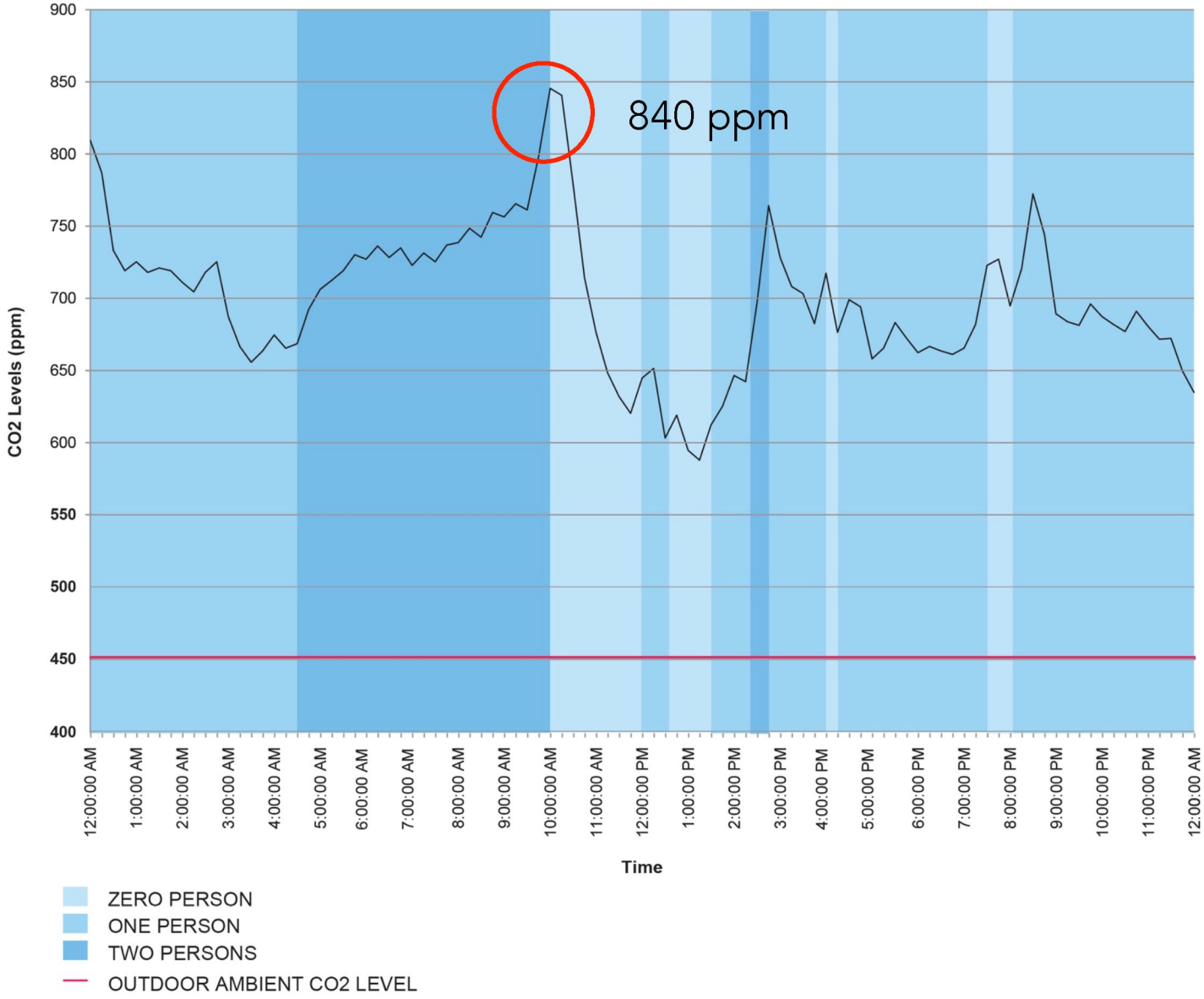
Sealed Door

Data

Outdoor CO2 Level

Time	CO_2 Level (ppm)
10:00 am	457
2:00 pm	430
6:00 pm	444
10:00 pm	462
Average	**448.25 ≈ 450**

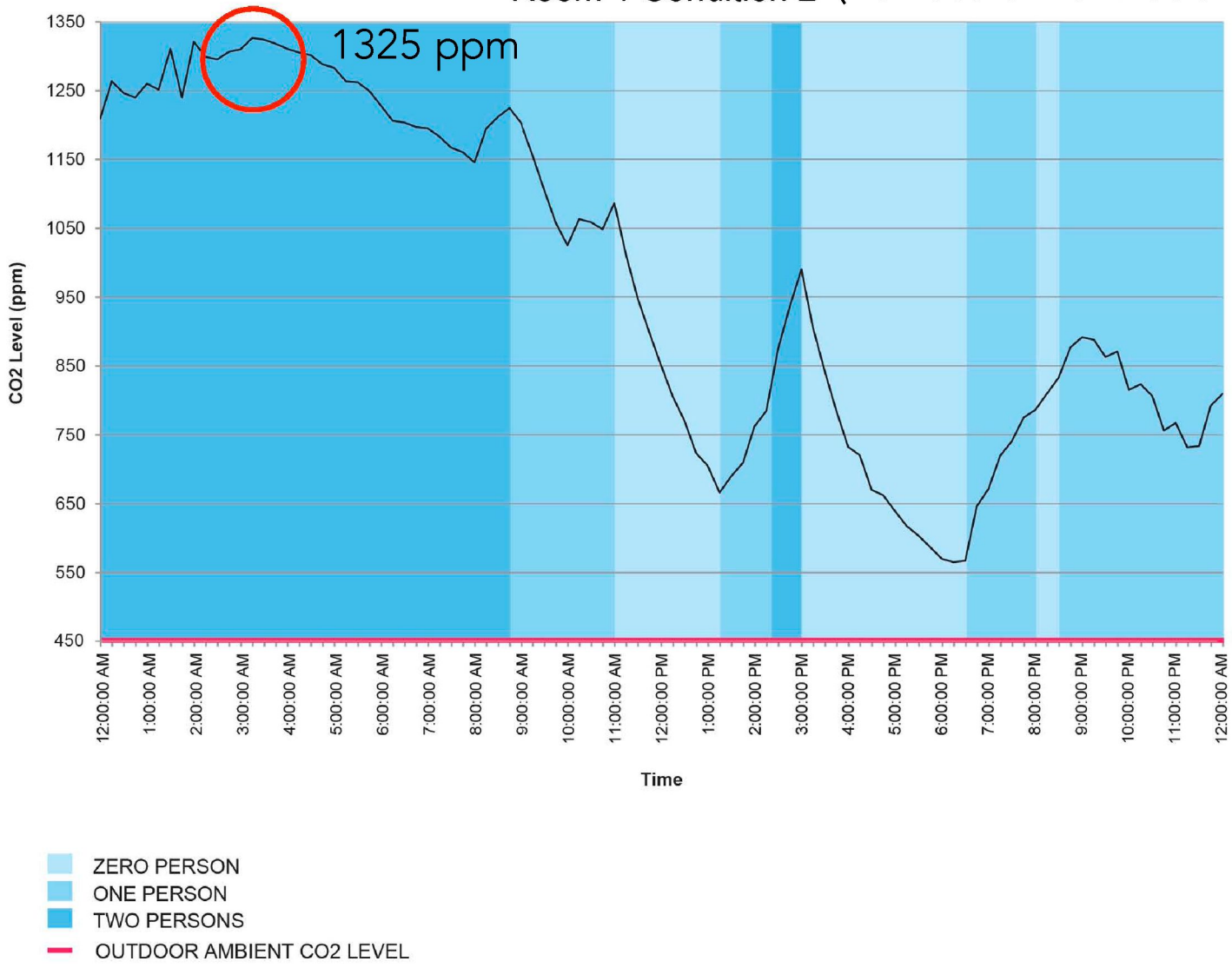
Room 1 Condition 1 (no natural ventilation)



840 ppm – 450 ppm = 390 ppm

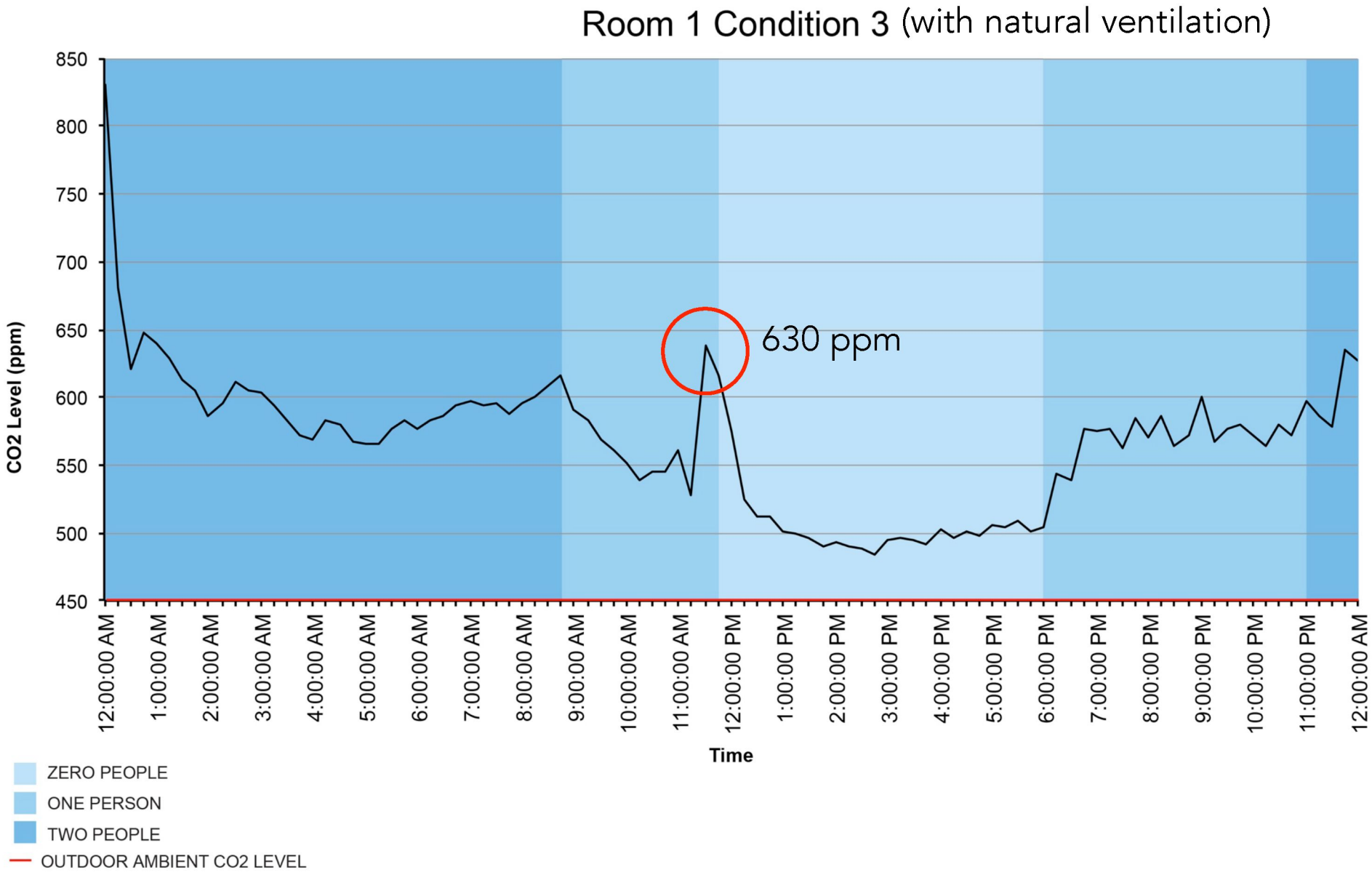
390 ppm < 4100 (2050 x 2 people) ppm (or 5 cfm/person, the goal)

Room 1 Condition 2 (no natural ventilation)



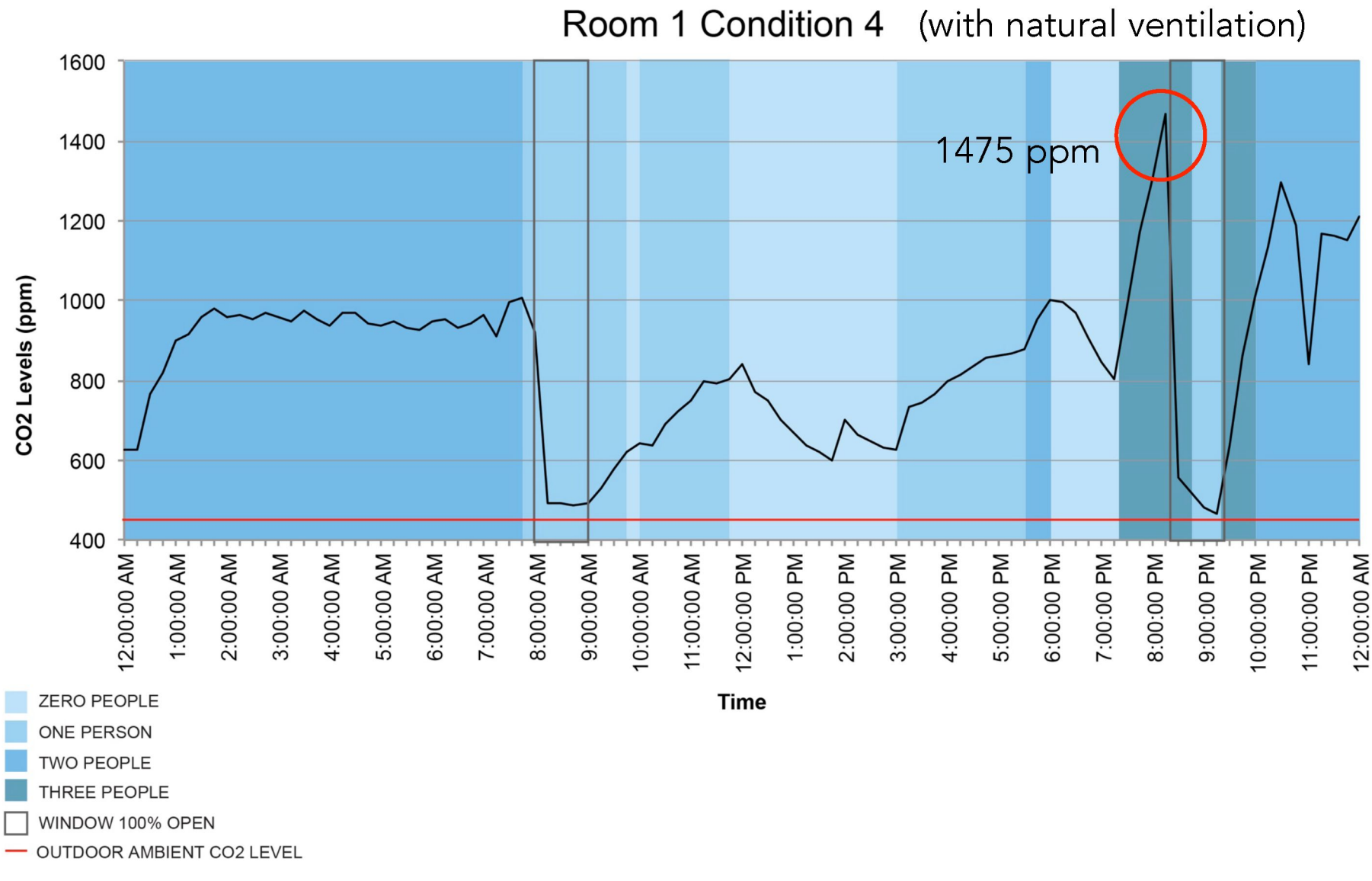
1325 ppm – 450 ppm = 875 ppm

875 ppm < 4100 (2050 x 2) ppm (or 5 cfm/person, the goal)



630 ppm – 450 ppm = 180 ppm

180 ppm < 2050 ppm (or 5 cfm/person, the goal)



1475 ppm – 450 ppm = 1025 ppm

1025 ppm < 6150 (2050 x 3) ppm (or 5 cfm/person, the goal)

Findings

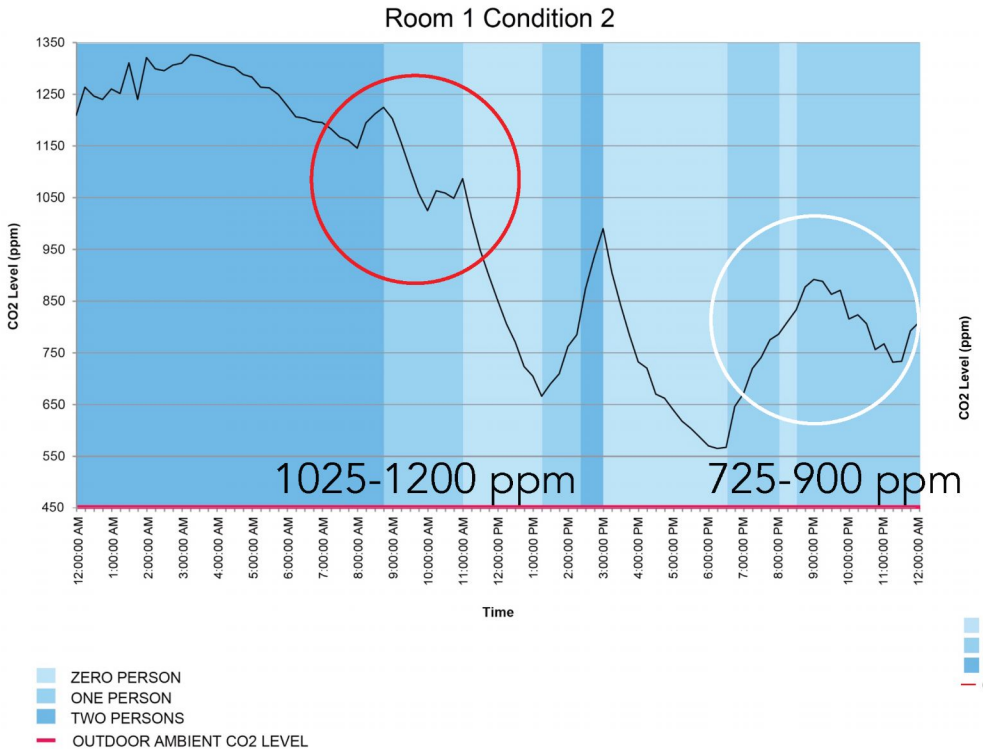
Hypothesis: Natural ventilation through a Barnhart dorm room window will exceed the ASHRAE standard 62.1-2013 of 5 cfm/person

- ALL CONDTIONS MET THE STANDARD
- 😊 Subjective Comfort Standard > ASHRAE Standard

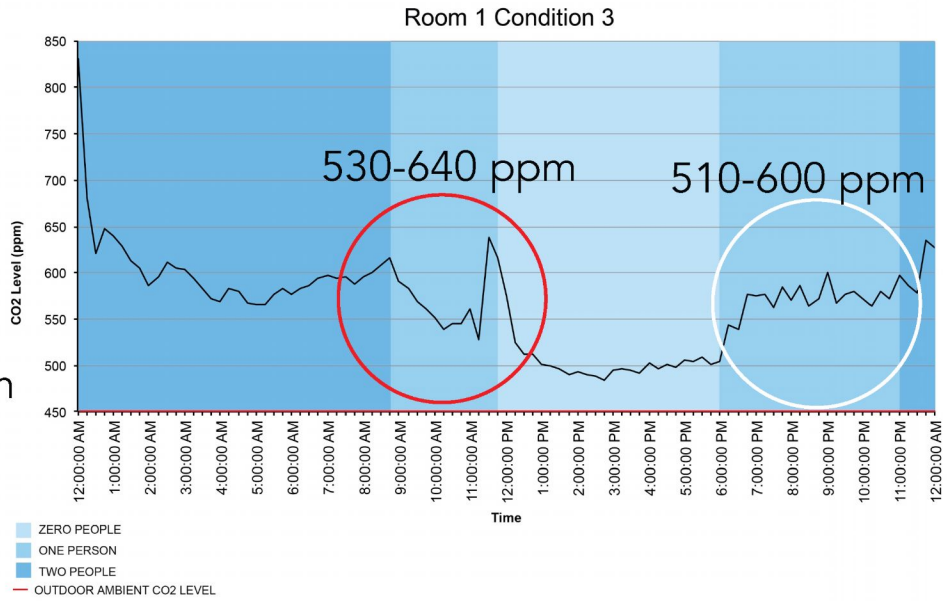
Increasing standard?

Findings

- Natural ventilation did reduce CO2 levels

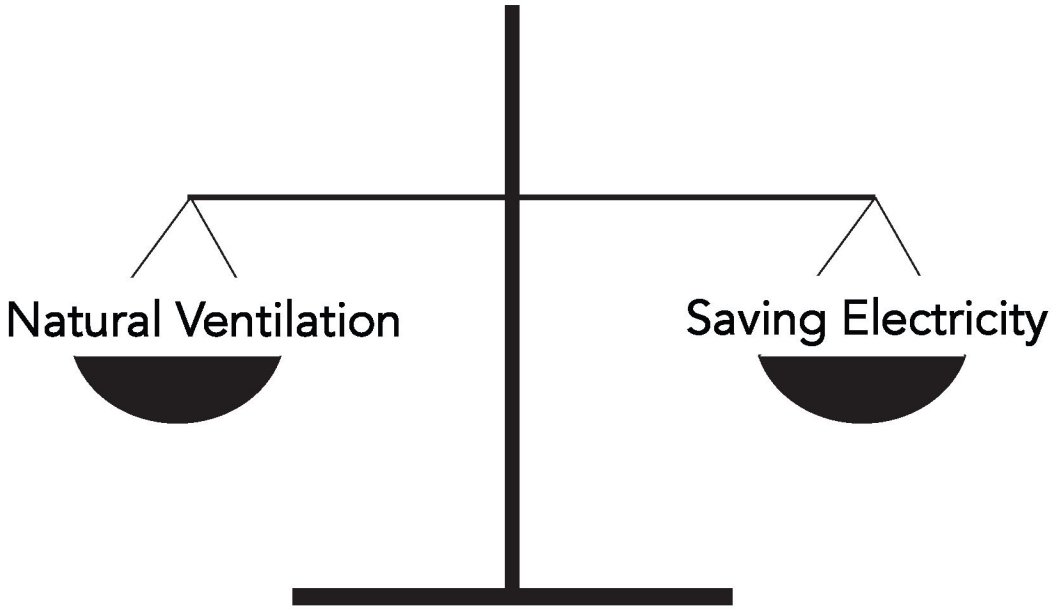


With natural ventilation

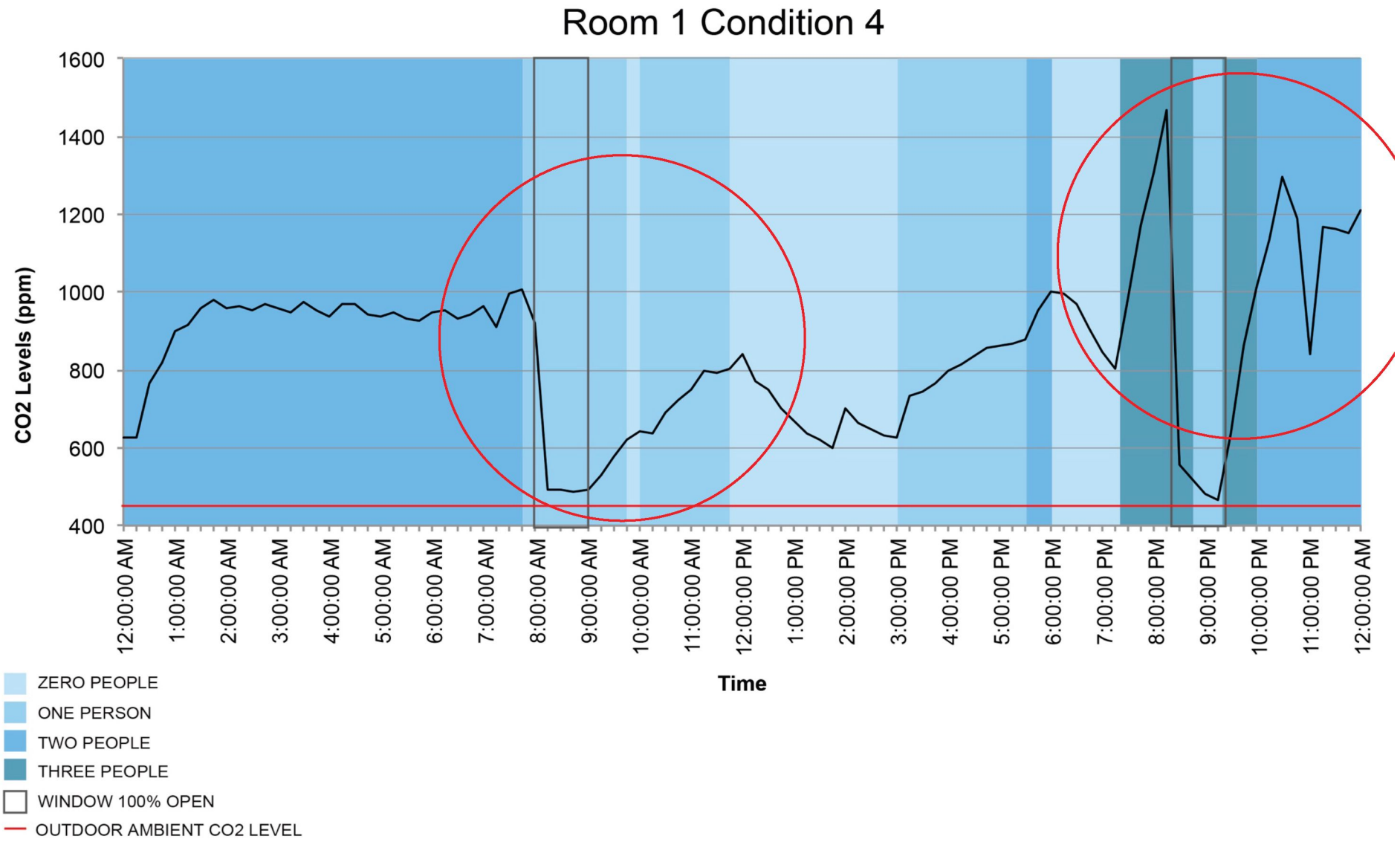


Big Picture

Finding a balance?



"One hour, save power!"



"One hour, save power!"

Thank you!