Ventilation for Acceptable Indoor Air Quality

Part 4 - How to Improve Demand Control Ventilation

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ASHRAE Standard 90.1-2019
Section 6 – HVAC

6.4.3.8 Ventilation Controls for High-Occupancy Areas

Demand control ventilation (DCV) is required for spaces larger than 500 ft^2 and with a design occupancy for ventilation of ≥25 people per 1000 ft^2 of floor area and served by systems with one or more of the following:

a. Air economizer.
b. Automatic modulating control of outdoor air damper.
c. Design outdoor airflow greater than 3000 cfm.

ASHRAE Standard 62.1-2019

Section 6.2 - Ventilation Rate Procedure (VRP)

6.2.6 Dynamic Reset. The system may be designed to reset the outdoor air intake flow (V_{ot}) and/or space or ventilation zone airflow (V_{oz}) as operating conditions change.

6.2.6.1 Demand Control Ventilation (DCV). DCV shall be permitted as an optional means of dynamic reset.

Exception: CO_2-based DCV shall not be applied in zones with indoor sources of CO_2 other than occupants or with CO_2 removal mechanisms such as gaseous air cleaners.

6.2.6.1.1 For DCV zones in the occupied mode, breathing zone outdoor airflow (V_{bz}) shall be reset in response to current population.

6.2.6.1.2 For DCV zones in the occupied mode, breathing zone outdoor airflow (V_{bz}) shall be not less than the building component ($R_a \times A_z$) for the zone.

ASHRAE Standard 62.1-2019

Section 6.2 - Ventilation Rate Procedure (VRP)

6.2.1.1 Breathing Zone Outdoor Airflow. The outdoor airflow required in the breathing zone of the occupiable space or spaces in a ventilation zone, i.e., the breathing zone outdoor airflow (V_{bz}), shall be no less than the value determined in accordance with Equation 6-1.

$$V_{bz} = R_p \cdot P_z + R_a \cdot A_z \qquad (6\text{-}1)$$

where

R_p = outdoor airflow rate required per person from Table 6-1

P_z = the CURRENT population of the ventilation zone during typical usage (see 6.2.6.1.1)

R_a = outdoor airflow rate required per floor area from Table 6-1

A_z = zone floor area

ASHRAE Standard 62.1-2019

Section 6.2 - Ventilation Rate Procedure (VRP)

Single Zone System DCV Compliance

1. Determine the population of the ventilation zone during actual usage: P_z

2. Calculate the outdoor airflow rate required, $V_{ot} = V_{oz} = \{R_p \cdot P_z + R_a \cdot A_z\}/E_z$, based on the actual population, P_z, and Table 6-1 for the space type and use.

3. Demonstrate the outdoor airflow rate provided during greater than or equal to V_{ot} during occupied periods.

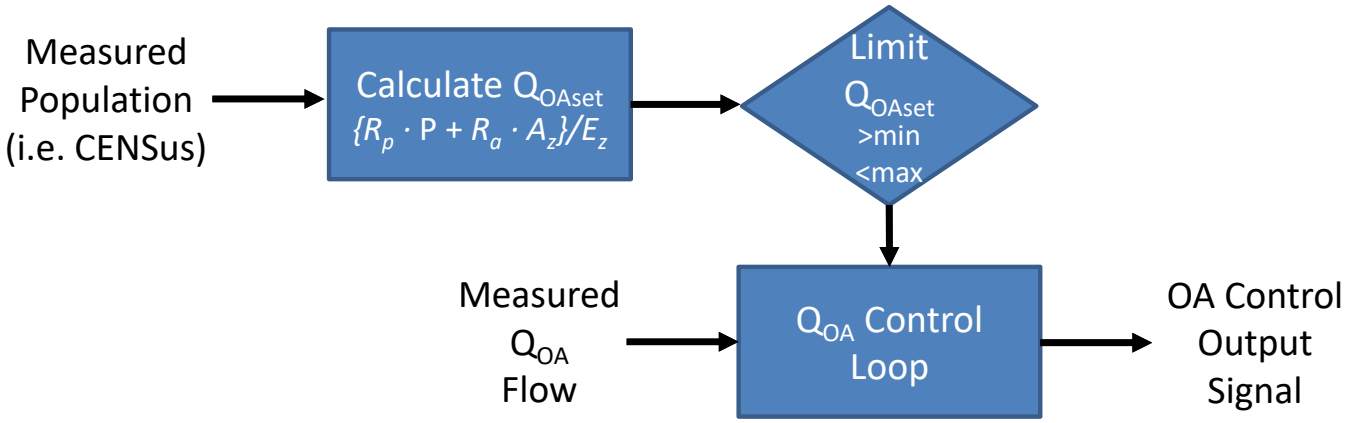

Why not
count
occupants?

Population Estimation Methods

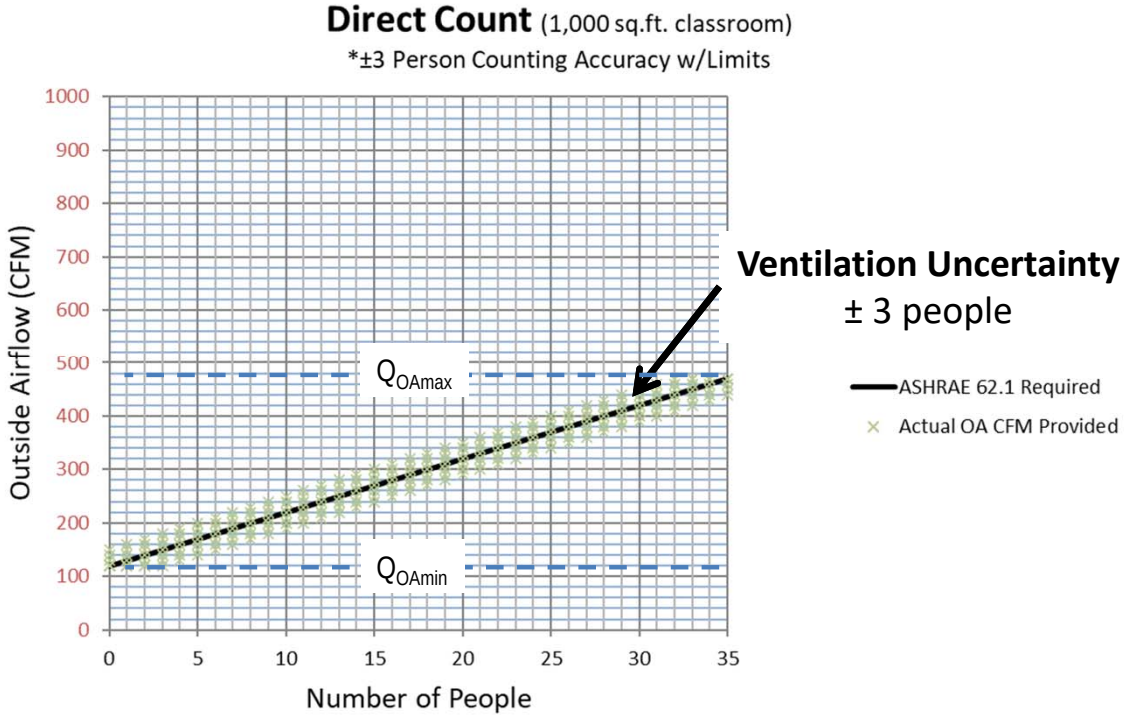
- Over-door counting systems (meeting rooms, conference rooms, classrooms, etc.)
- Turnstiles or ticket counting systems (arenas, convention centers, etc.)
- RFID card counting systems (offices)
- Video imaging counting systems (casinos)
- POS Systems (theaters, etc.)
- More …

Think outside the box!

Population-based Ventilation Control

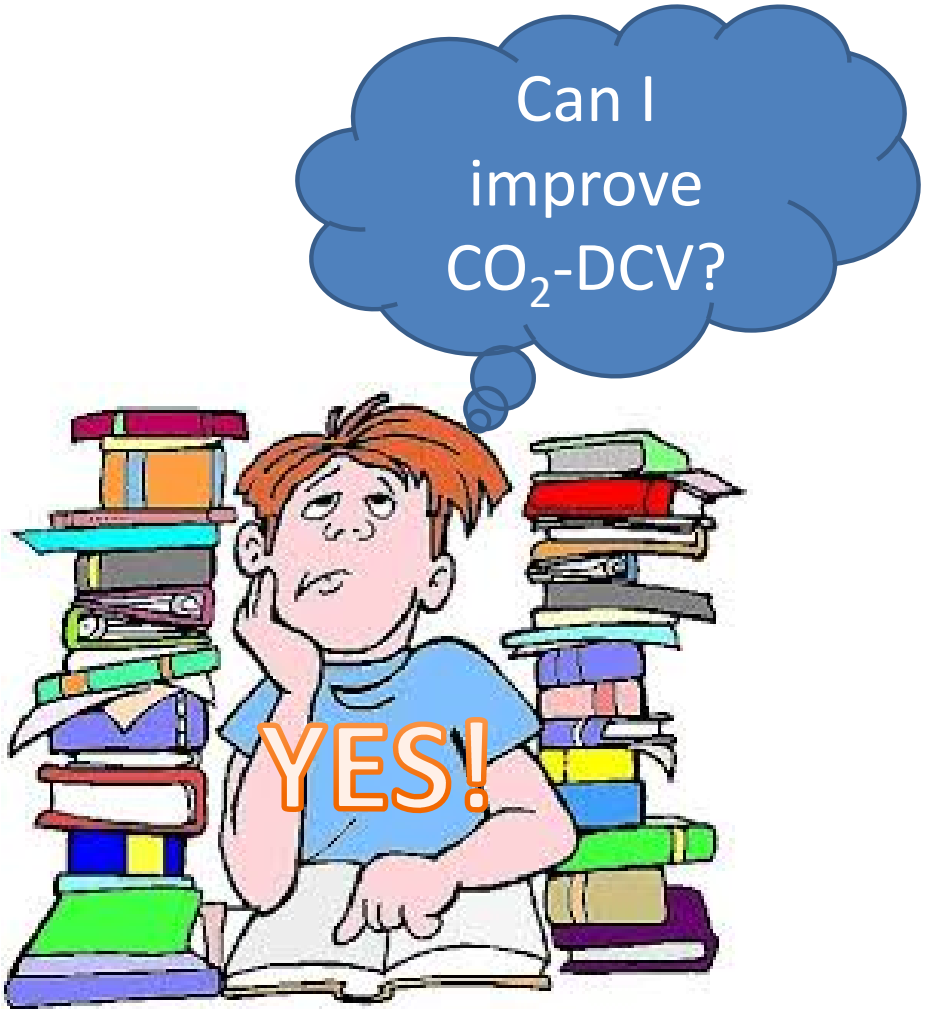


62.1 Direct Count Ventilation Control

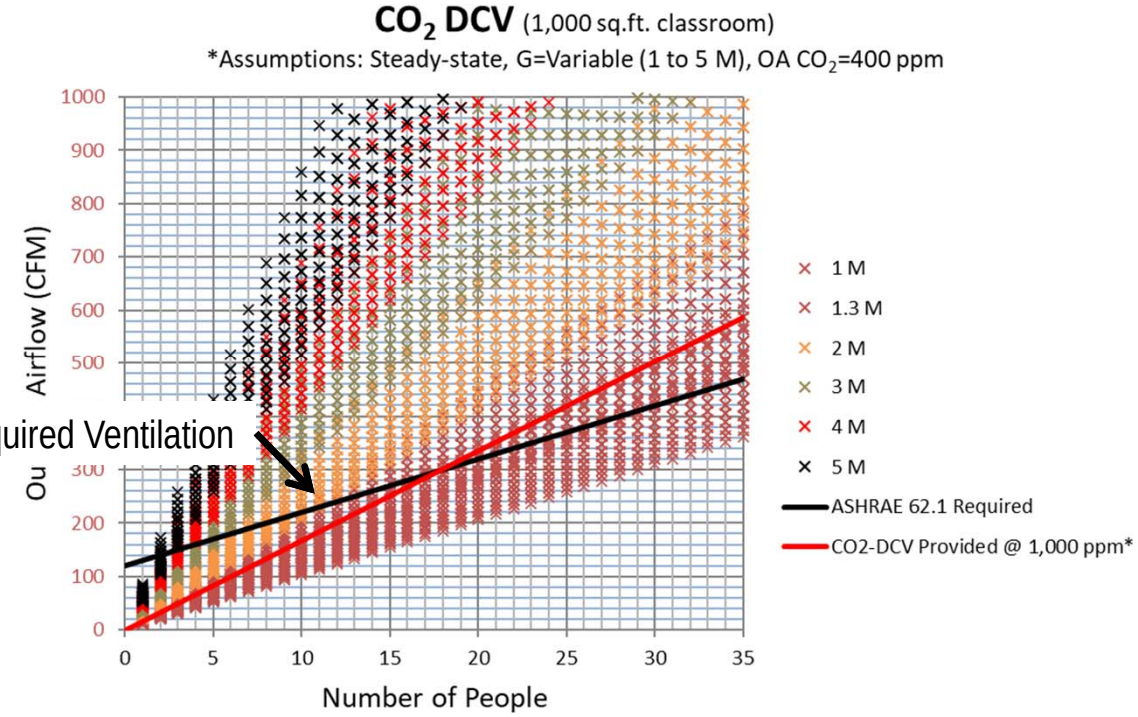


No LAG error!


I have to use CO_2 to satisfy my energy code?


Can I improve CO_2-DCV?
YES!

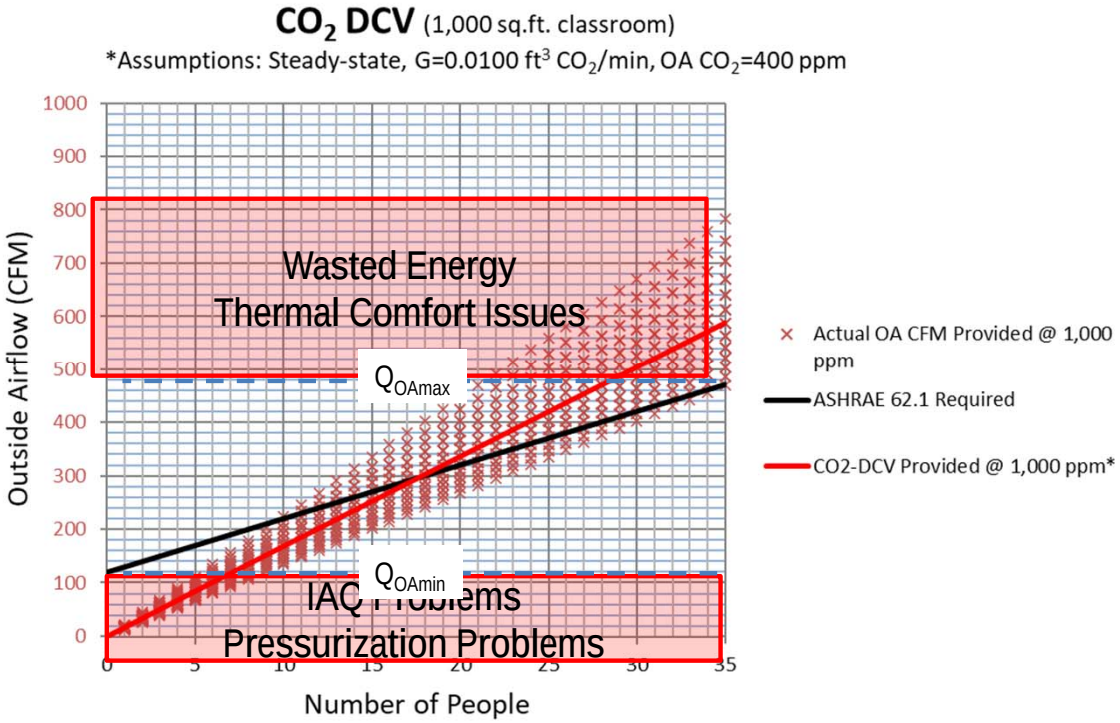
Account for activity level and age.



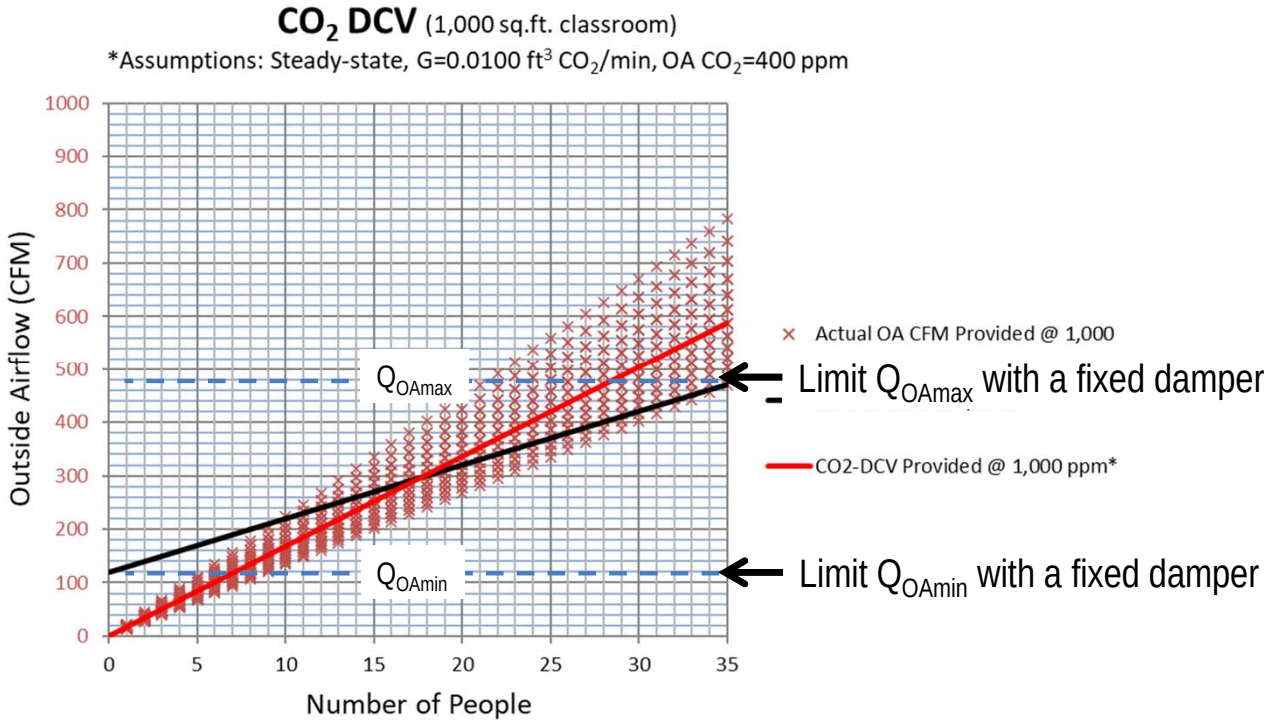
ASHRAE 62.1-2019 Required Ventilation

Note: G based on average male 20 to 60 years old (addendum ab)

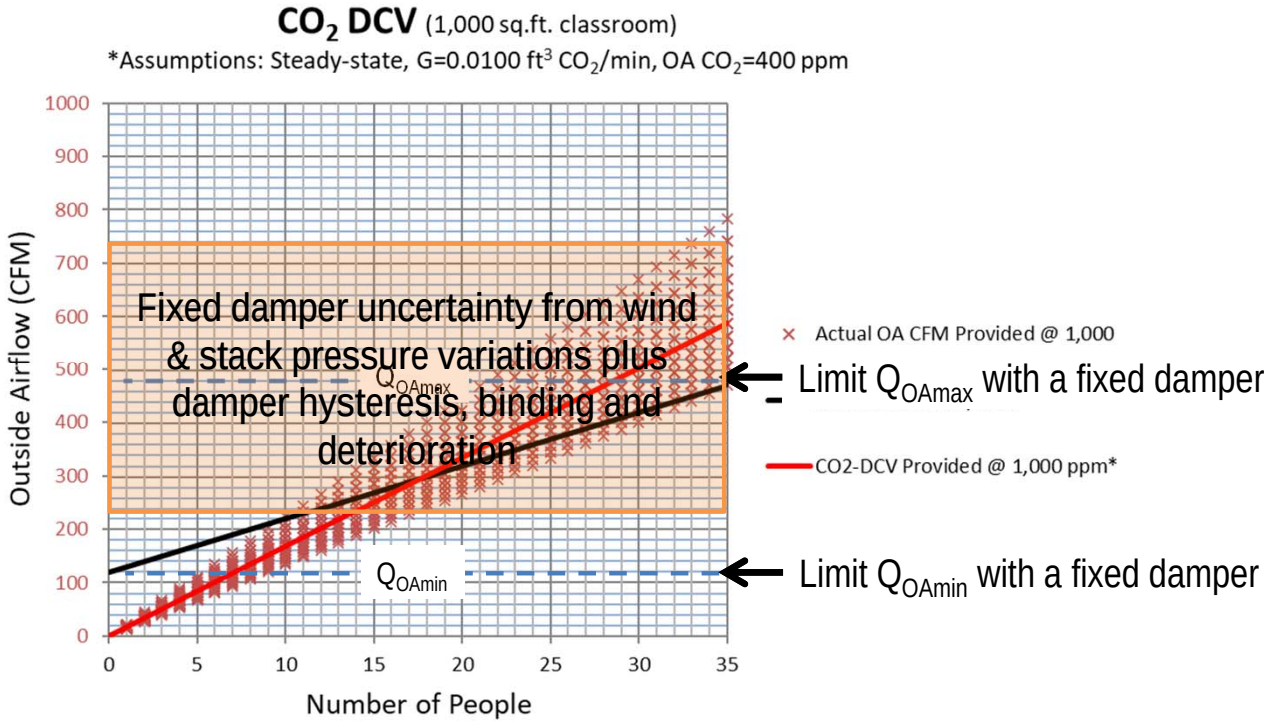
Set limits to offset errors.



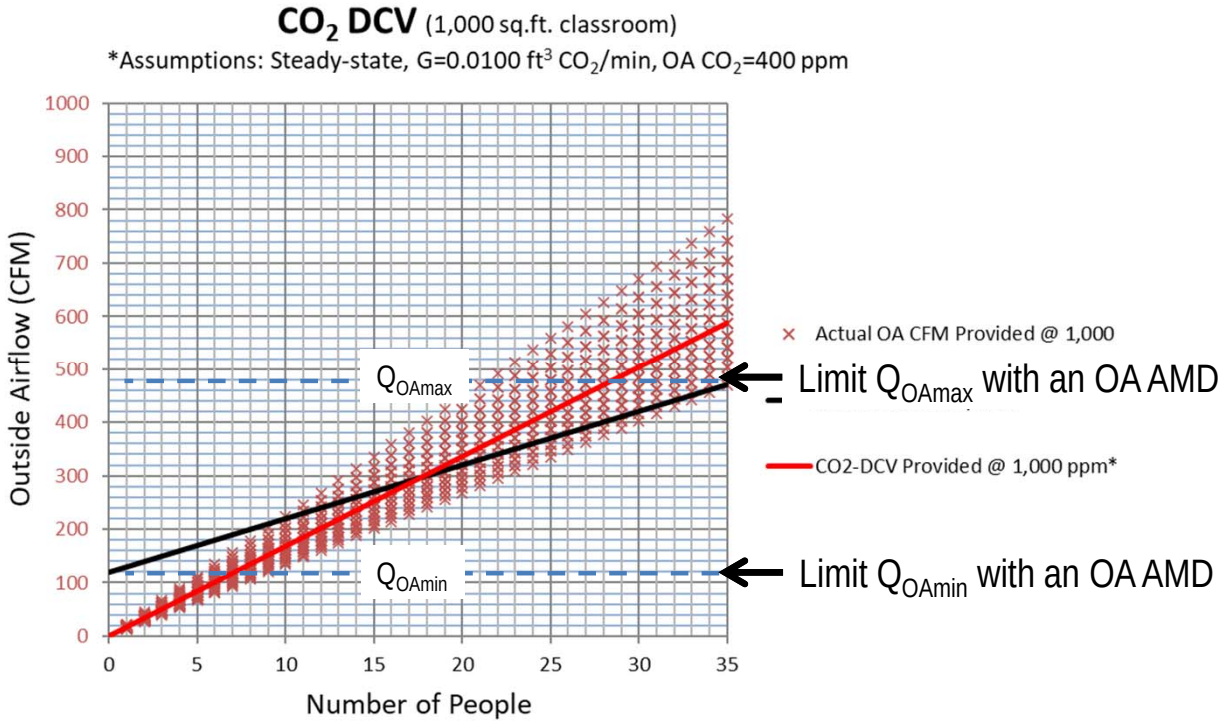
How do most systems limit OA ventilation?



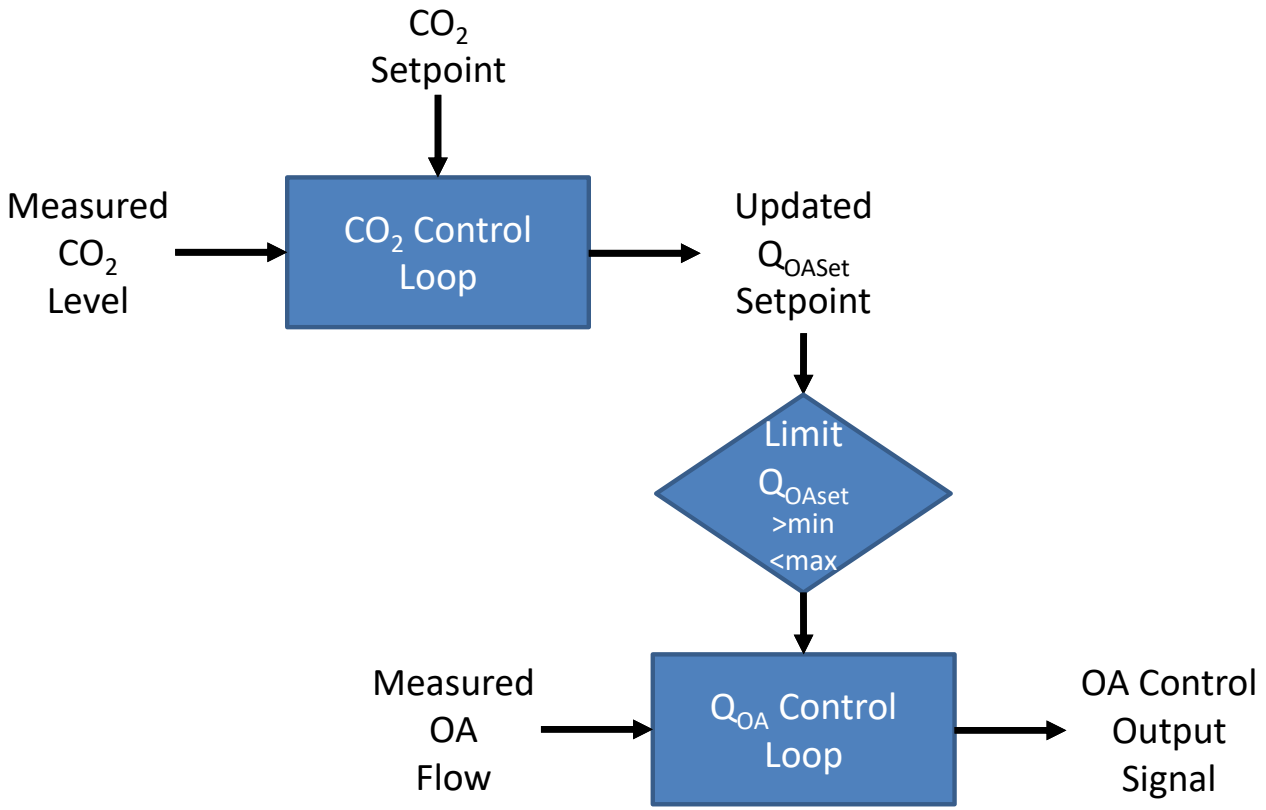
Fixed damper positions do not work!



Improve CO_2-DCV with Airflow Measurement!



Fixed Setpoint CO_2-DCV w/Airflow Limits



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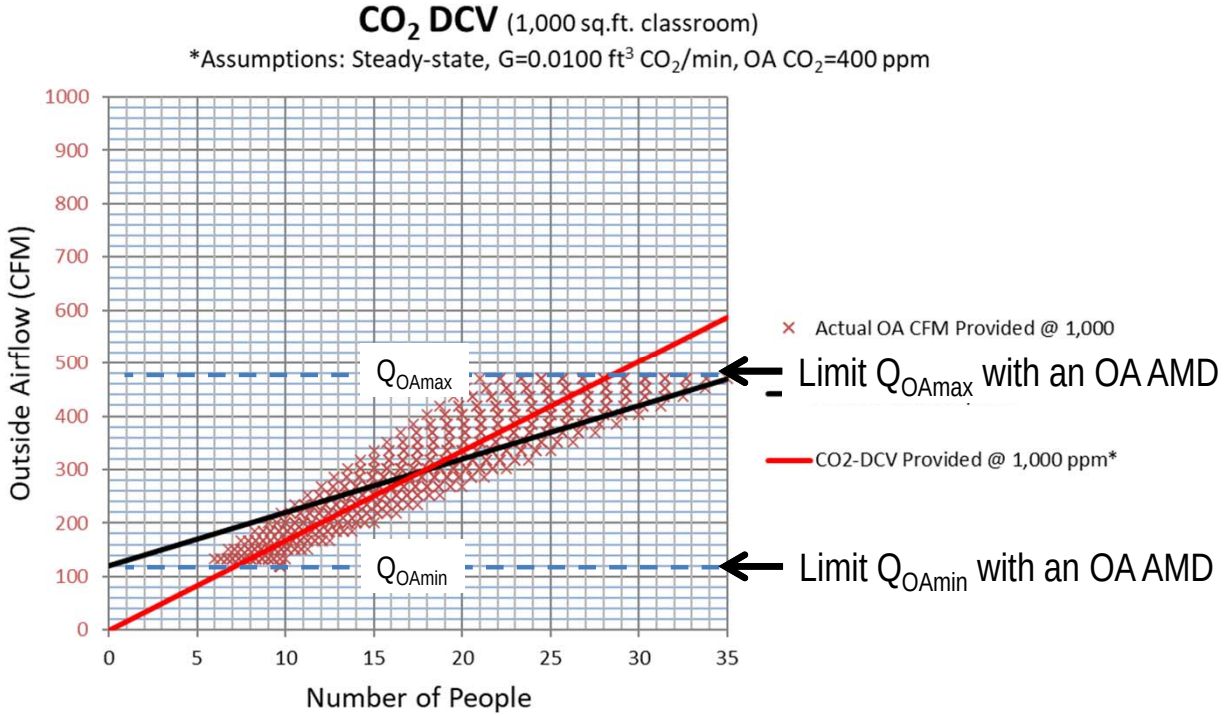
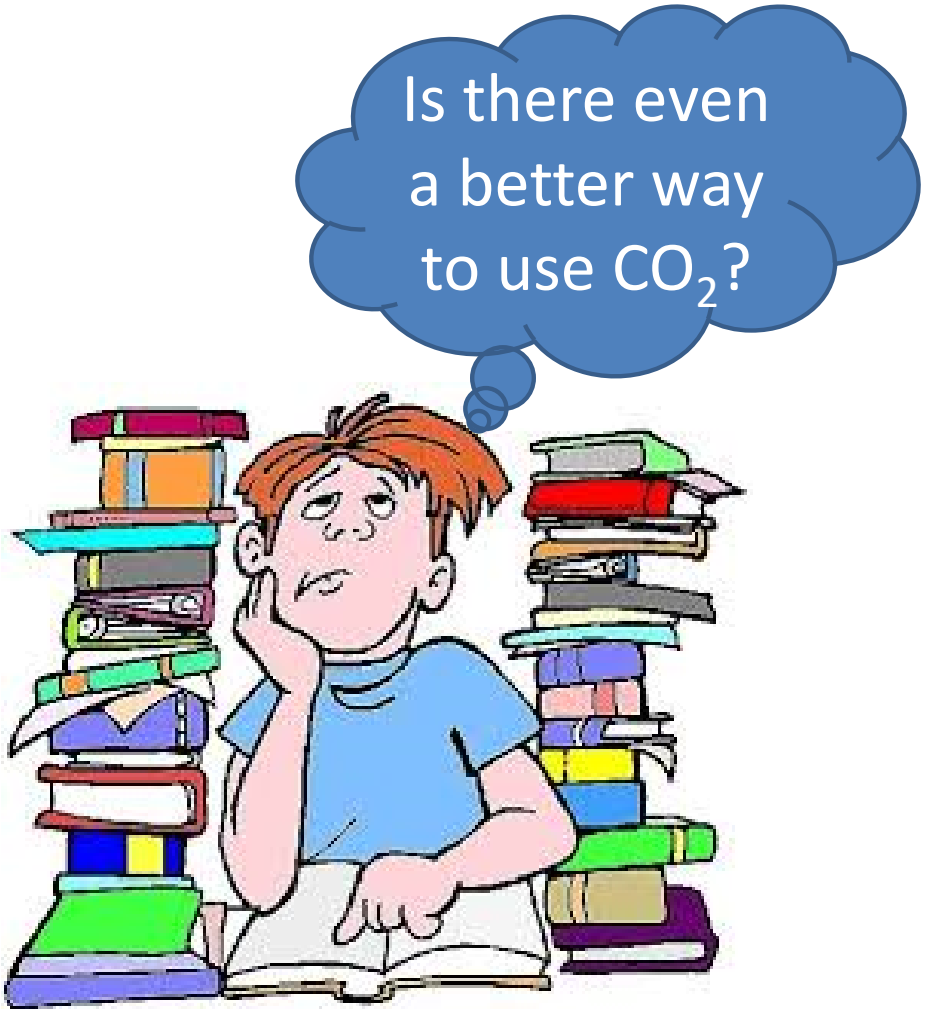


IgCC 2018 powered by ASHRAE 189.1-2017

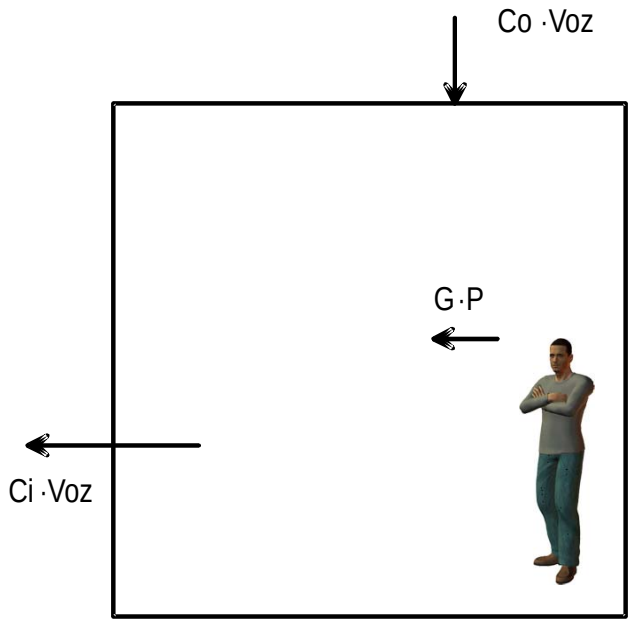
Section 8 – Indoor Environmental Quality

801.3.1.2.2 (8.3.1.2.2) Monitoring Requirements. Each mechanical ventilation system shall have a permanently installed device to measure the minimum outdoor airflow that meets the following requirements:

Exception to 801.3.1.2.2 (8.3.1.2.2): Constant-volume air supply systems that do not employ demand control ventilation and that use an indicator to confirm that the intake damper is open to the position determined during system startup and balancing, needed to maintain the design minimum outdoor airflow.


Is there even a better way to use CO_2?

CO_2 and Ventilation



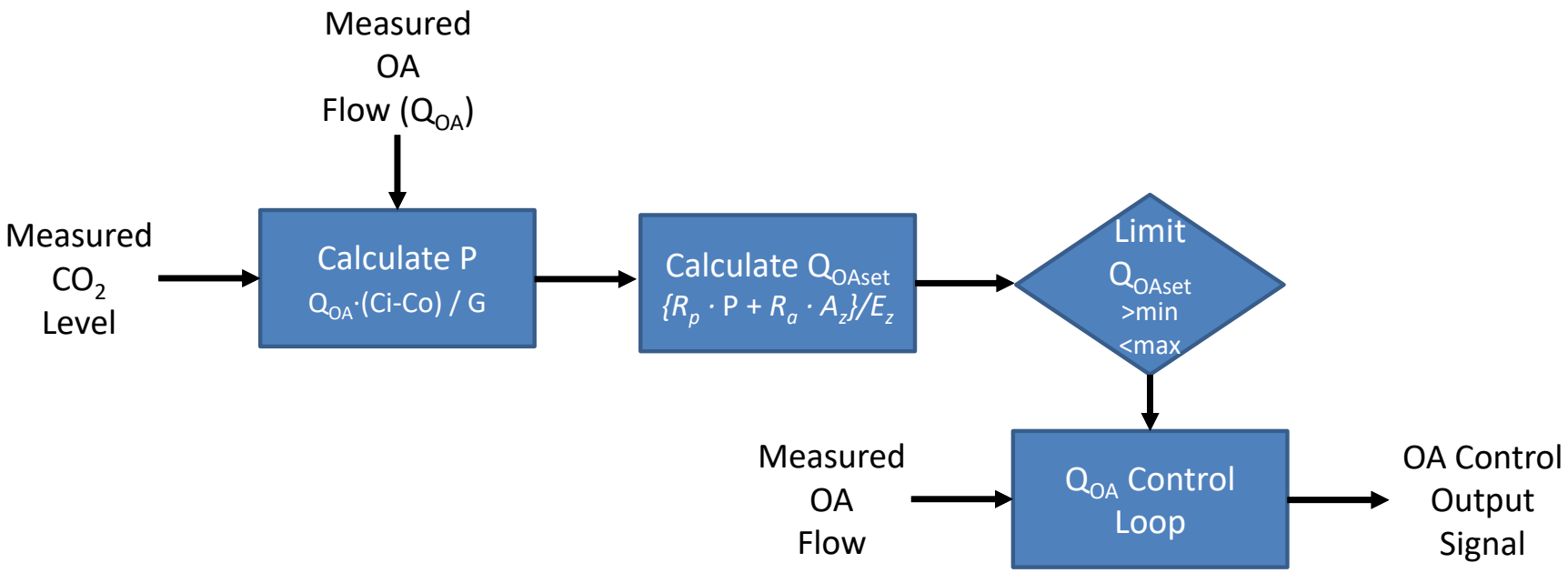
Co = Outdoor CO_2 concentration (ft^3 CO_2/ft^3 air)
Ci = Indoor CO_2 concentration (ft^3 CO_2/ft^3 air)
Voz = Q_{OA} = Outside Airflow Rate (ft^3/min)
Vo=Outside Airflow Rate/Person ((ft^3/min)/person)
G = CO_2 generation rate of the occupant (ft^3 CO_2/min)
P = Number of occupants

Steady-state Mass Balance: In = Out
Co·Voz + G·P = Ci·Voz

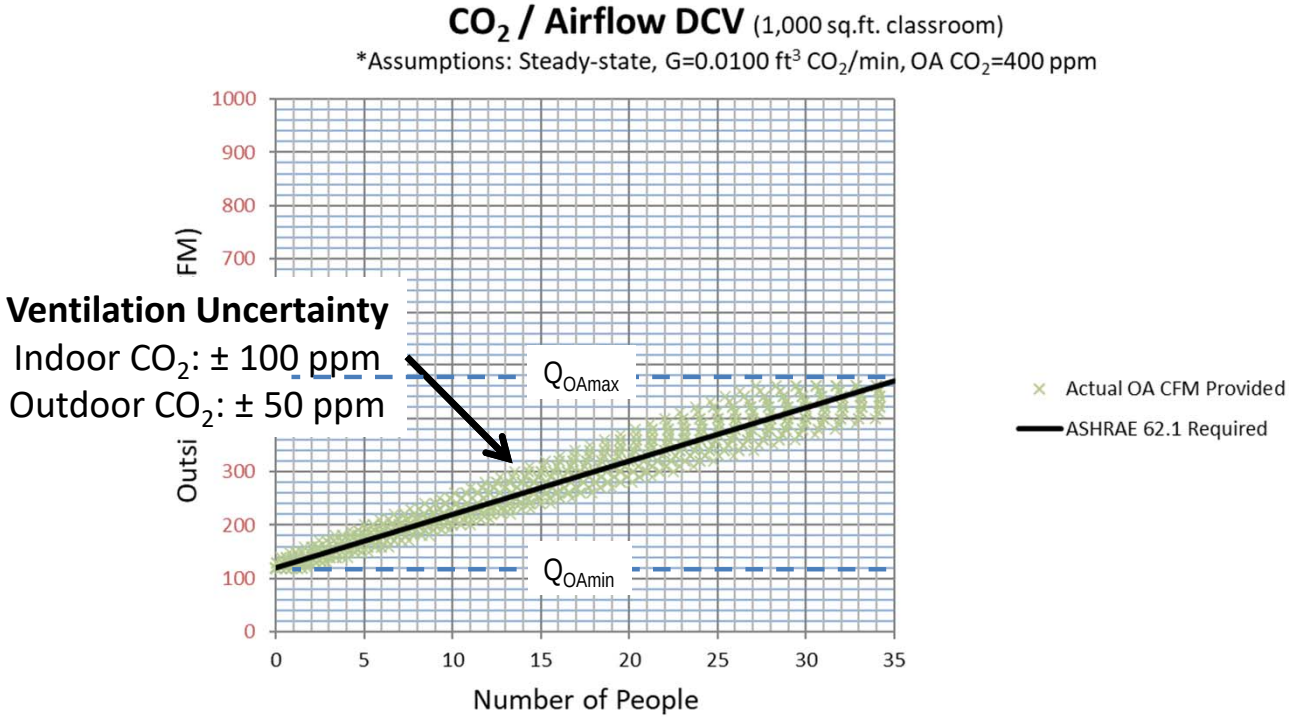
Can be rearranged as:

Voz·(Ci-Co) / G = P = People!

62.1 CO_2/OAF Ventilation Control



62.1 CO_2/OAF Ventilation Control



Ventilation Uncertainty

Indoor CO_2: ± 100 ppm

Outdoor CO_2: ± 50 ppm

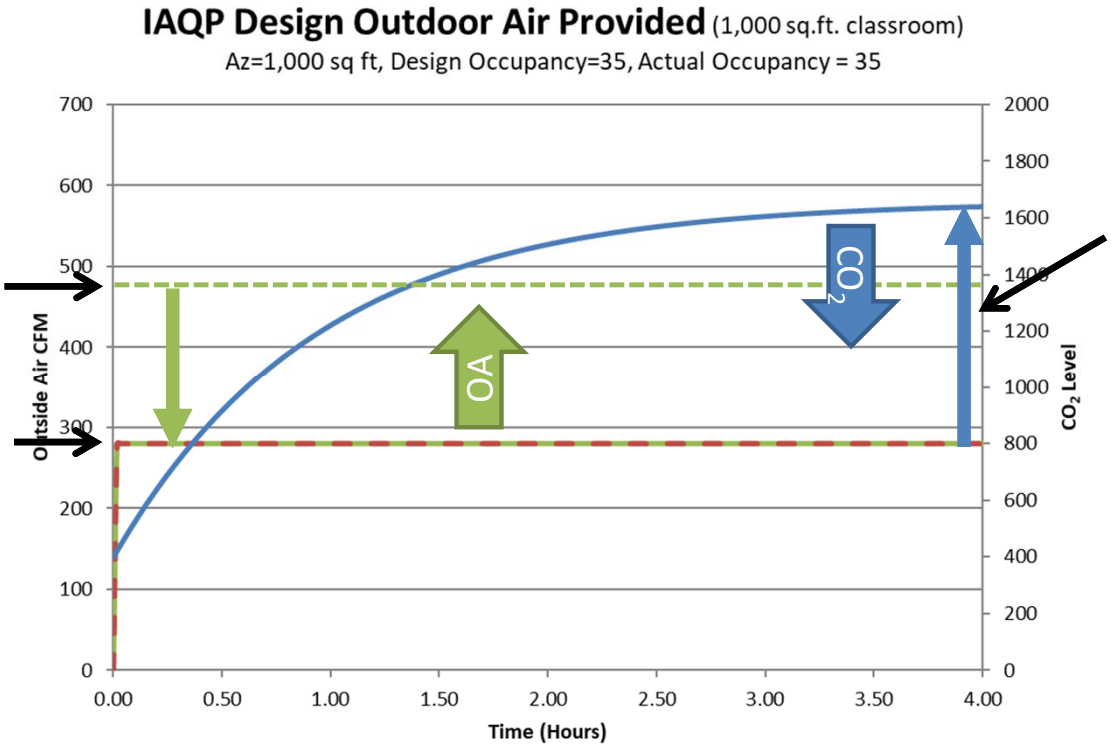

How do reduced airflow rates when using the IAQP affect CO_2 levels and ventilation?

CO_2 and Ventilation

Contaminant Removal System without CO_2 removal capability

VRP Required Ventilation

IAQP Reduced Ventilation



Steady-state CO_2 Increase


Why does the VRP not allow DCV when CO_2 removal systems are used?

ASHRAE Standard 62.1-2019

Section 6.2 - Ventilation Rate Procedure (VRP)

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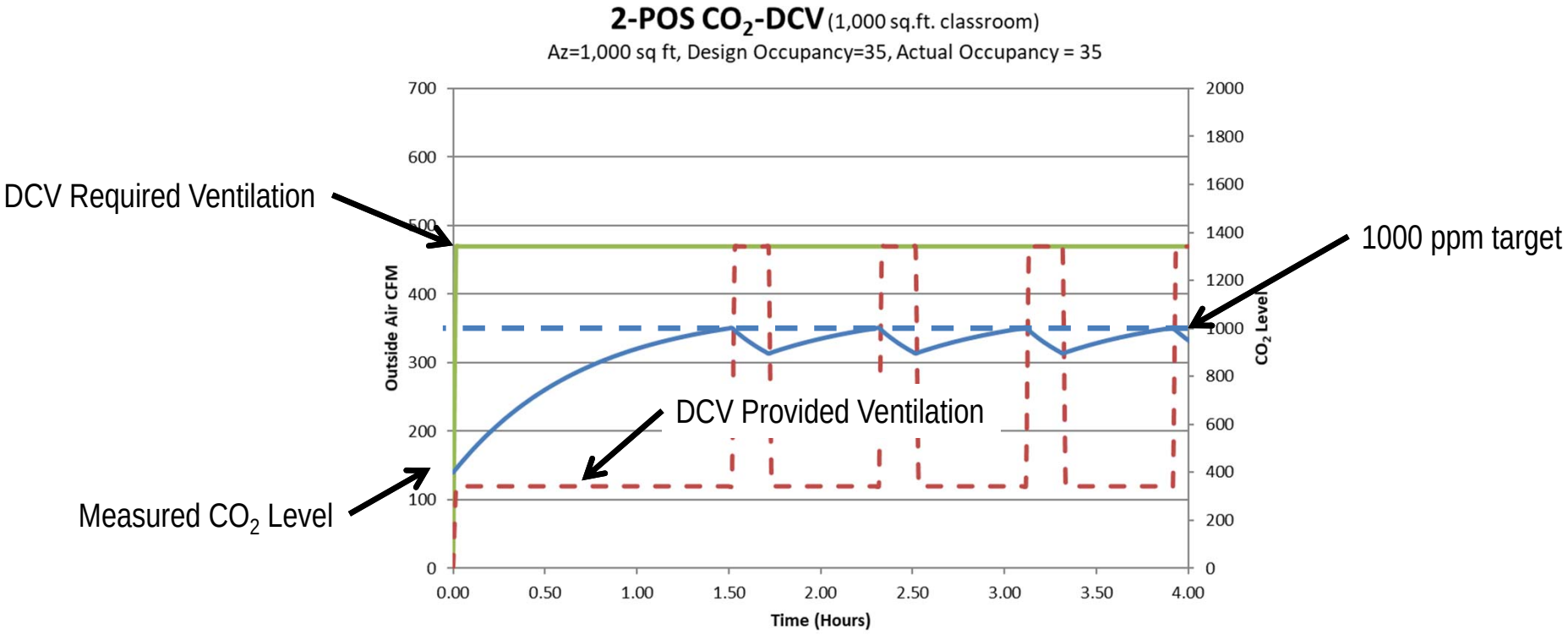
CO_2 and Ventilation

Contaminant Removal System with CO_2 removal capability



Thank You!

Questions? More information?

AskDave@EngineeredSalesCorp.com