

# ***CO<sub>2</sub>-based Ventilation Control***

## ***A Solution for Schools***



imagination at work

# *Proper Ventilation ...*

**Having the correct amount of outside  
air entering the building**

**Too Much Ventilation = Wasted Energy**

**Not Enough Ventilation =  
Unhealthy, Non-compliant Building**

# How many schools have improper ventilation?

## Environmental Health Conditions in CA's Portable Classrooms (Nov. 2004)

- Study found CO2 levels above 1,000 ppm:
  - 42% of the time in portable classrooms
  - 43% of the time in traditional classrooms
- Study found CO2 levels above 2,000 ppm:
  - 9% of the time in portable classrooms
  - 10% of the time in traditional classrooms

By: CA Air Resources Board, CA Dept. of Health Services

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# ***CO<sub>2</sub>-based Ventilation Control***

*aka Demand Controlled Ventilation (DCV)*

## ***Is the Solution***



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# How CO<sub>2</sub>-based ventilation control works .....

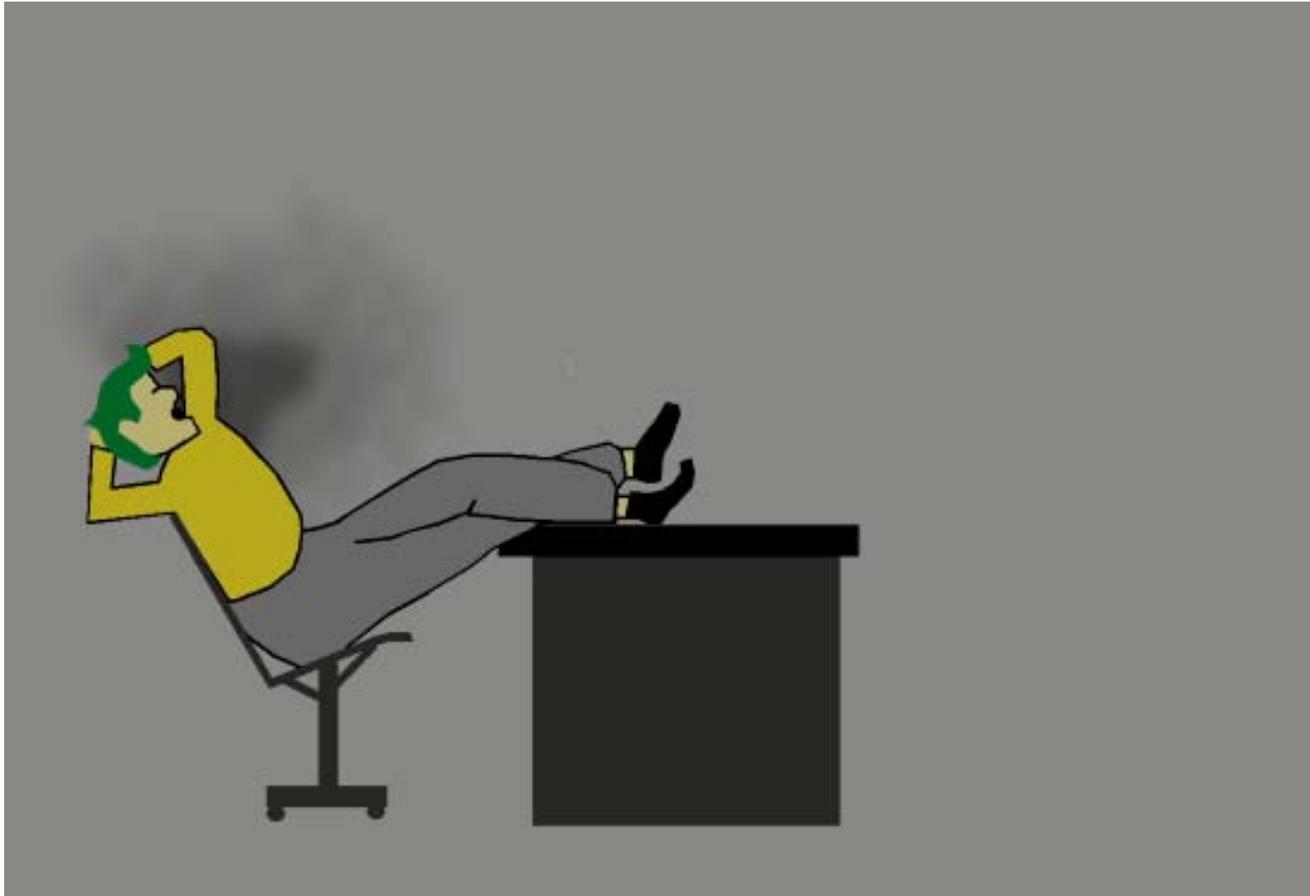
**We inhale oxygen and exhale CO<sub>2</sub>**

**Outdoor air (ventilation) dilutes the exhaled CO<sub>2</sub>**



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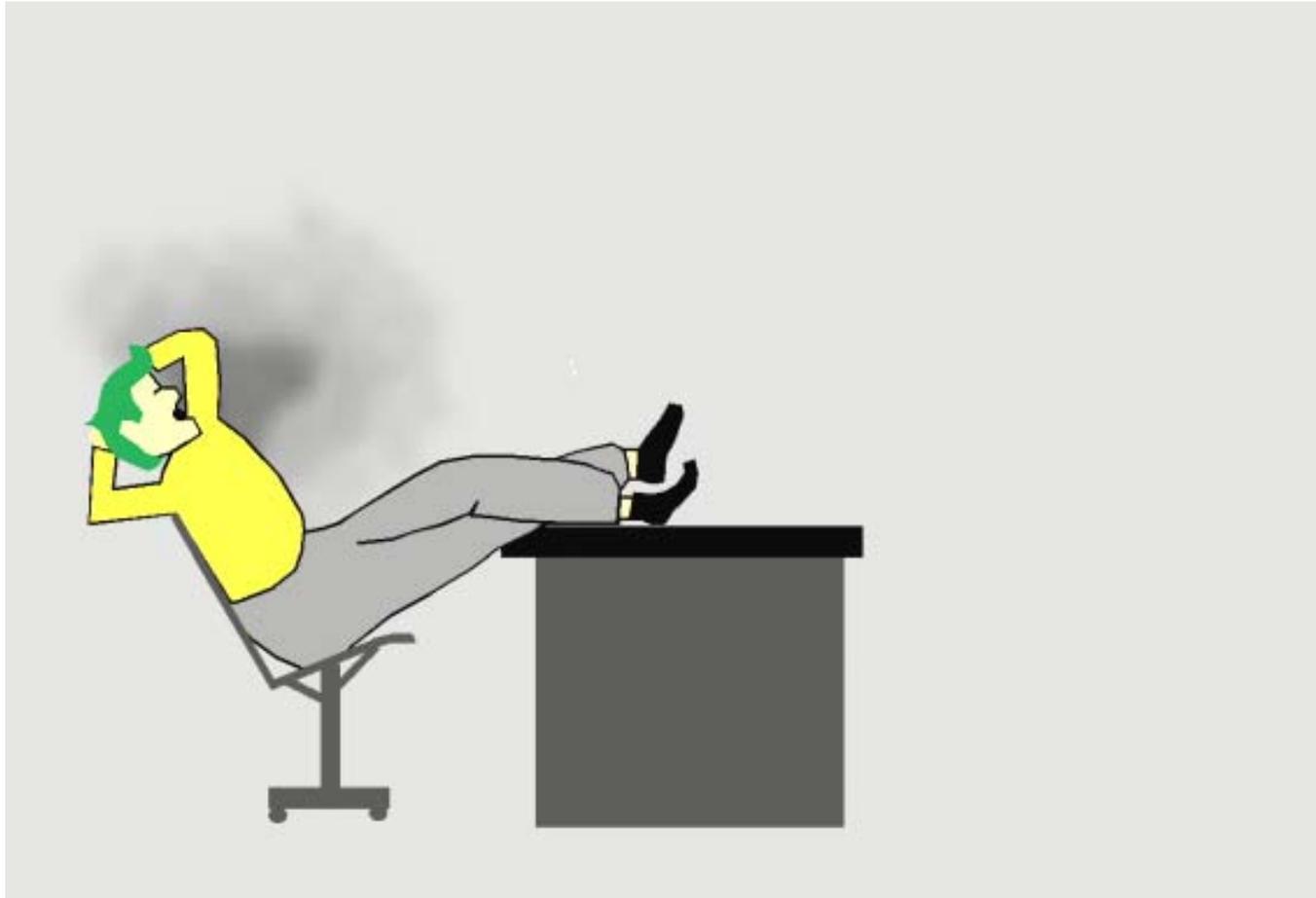
**A build-up of CO2 means you don't have enough ventilation (outside air) coming into the room**



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***CO2 = Ventilation***

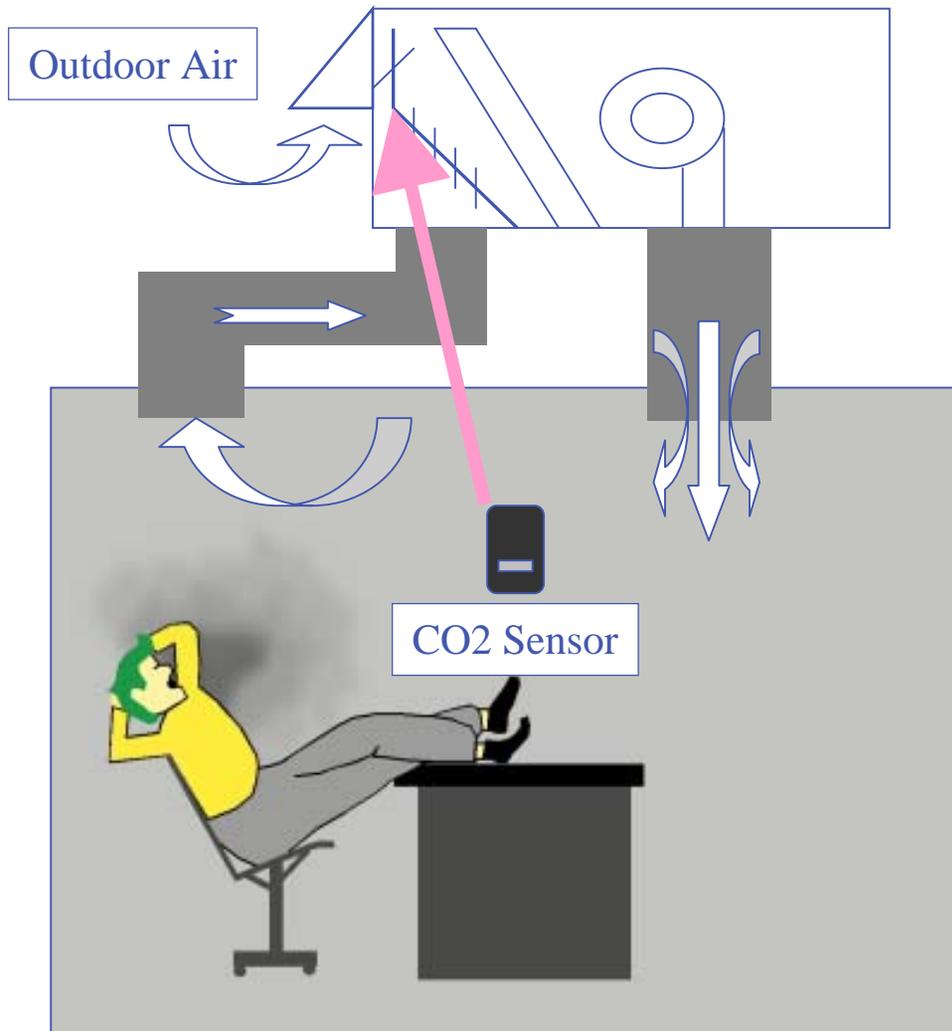
**Low CO2 levels means there's more ventilation than is required coming into the room**



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***CO2 = Ventilation***

# CO2-based Ventilation Control



**Controlling the outdoor air intakes with a CO2 Sensor to maintain ~1,100 ppm ensures proper ventilation**



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# ***CO<sub>2</sub>-based Ventilation Control Benefits for Schools***

- Helps Ensure Healthy Environment  
Reduces Absenteeism  
Increases Funding**
- Improves Student Performance**
- Reduces Risk**
- Saves Energy**



***Provides a Healthy Environment***  
***Reduces Absenteeism***  
***Increases Funding***

# Proper Ventilation = Healthy Environment

## Studies Prove It ...

### Indoor Air (2004; 14 Suppl 7:102-18) Summary of Human Responses to Ventilation Pupils Health & Performance In Regard To CO<sub>2</sub> Concentrations

- Ventilation has a significant impact on ...
  - Communicable respiratory illnesses
  - Sick building syndrome symptoms
  - Task performance and productivity
  - Perceived air quality
  - Respiratory allergies and asthma

Seppanen, Fisk

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# Reduces Absenteeism

## Studies Prove It ...

**Indoor Air Magazine (2004 Oct; 14(5): 333-41)**

**Associations between classroom CO2 concentrations and student attendance in WA and ID**

Inadequate ventilation was associated with a 10 to 20% increase in student absence

Shendell, Prill, Fisk, Apte, Blake, Faulkner

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# Reduces Absenteeism

## Funding Benefit from Improved Absenteeism

# of Students = 100,000

Average daily attendance = 95%

Annual funding per student = \$5,000

Absenteeism Reduction	Increased School Funding
5%	\$1,250,000
10%	\$2,500,000
15%	\$3,750,000
20%	\$5,000,000



# *Improves Student Performance*

# Improves Student Performance

## Studies Prove It ...

### “Effects of HVAC on Student Performance”

Wargoeki and Wyon, ASHRAE Journal, October 2006

#### Finding:

**Maintaining CO2 levels at or below 1,000 ppm significantly increased student performance on many tasks**

#### Conclusion:

**“air quality and temperature ... should be given as much priority as improving teaching materials and methods”**

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# Improves Student Performance

## Studies Prove It ...

### DesignShare: Designing for the Future of Learning Indoor Air Quality in Schools (IAQ): The Importance of Monitoring Carbon Dioxide Levels

- “CO2 monitoring is a must for maintaining high quality in the classroom”
- “CO2 levels give a good idea of the quality of indoor air”
- “young children are the most vulnerable to the effects of poor indoor air quality”

Sundersingh, D.; Bearg, D. <http://www.designshare.com>

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***Reduces risk***

# Reduces Risk

## *CO<sub>2</sub> = Ventilation*

There is a clearly defined relationship between indoor CO<sub>2</sub> levels & ventilation rates established by:



ASHRAE 62.1 & 90.1



ASTM CO<sub>2</sub> &  
Ventilation Standard



EPA "Tools for Schools"

# CO<sub>2</sub> is the control parameter for ventilation!

# Reduces Risk

*CO2 = Compliance*



**Building Codes and Standards  
Specify Ventilation Rates**



**CO2 Readings = Ventilation Rates**



**CO2 = Compliance  
Can Be Measured & Documented!**

# Reduces Risk

How can CO2 control help?

## Proof of Compliance

*“Tell us Mr. Smart,  
do you know the  
ventilation rate in the  
classroom when little  
Johnny got sick?”*



**CO2 control is the answer!**

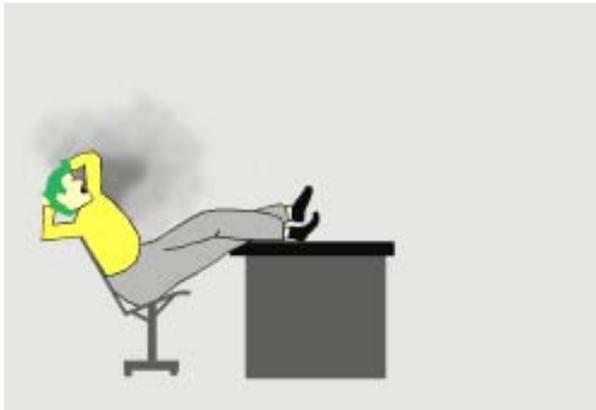


***Saves Energy***

# Saves Energy



**High CO2 Level**  
(Not Enough Ventilation)  
=  
**Unhealthy Environment**

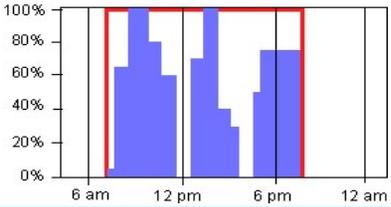


**Low CO2 Level**  
(Too Much Ventilation)  
=  
**Wasted Energy!**

# Saves Energy

# Matching Ventilation to Actual Load Saves \$\$\$'s

# Typical Payback Period is 8 to 18 months

CO2 DCV Energy Savings Analysis		School/Meeting/Lecture Room	
% of Design Occupancy			
Fixed Ventilation Schedule			
Floor Area	800 sq ft		
Ceiling Height	10 ft		
Design Occupancy	30 people		
Ventilation Rate (cfm/person)	15 cfm/person		
Base Ventilation Rate For DCV	30% of Design		
Heating/Cooling	NGas/Electric		
Ventilation Schedule	Weekdays 7:30am - 9:00pm Unoccupied Weekends		
Location	Annual Savings		
	Total \$	\$/sq ft	
Miami, FL	\$ 169.00	\$ 0.39	
Baltimore, MD	\$ 271.00	\$ 0.58	
Boston, MA	\$ 283.00	\$ 0.62	
Chicago, IL	\$ 235.00	\$ 0.52	
St Louis, MO	\$ 234.00	\$ 0.52	
Houston, TX	\$ 162.00	\$ 0.38	
Los Angeles, CA	\$ 76.00	\$ 0.17	
Portland, OR	\$ 178.00	\$ 0.27	
Toronto, Ont	\$ 294.00	\$ 0.64	



# Saves Energy



**GE Sensing-  
Telaire's  
Ventulator energy  
analysis program  
estimates the  
annual energy  
savings**

# ***CO2-based Ventilation Control Benefits for Schools***

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- Reduces Risk**
- Saves Energy**

# How GE Sensing Can Help !

## 1. CO2 control in schools website:

<http://www.gesensing.com/market/education.htm>

a. CO2 Control in Schools 'White Paper'

b. Ventulator energy analysis program

c. DCV: Where Required & Recommended



## 2. Full line of CO2 sensing products



# *How GE Sensing can Help!*

Contact GE Sensing for more information about  
CO2-based Ventilation Control



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[Info@telaire.com](mailto:Info@telaire.com)