



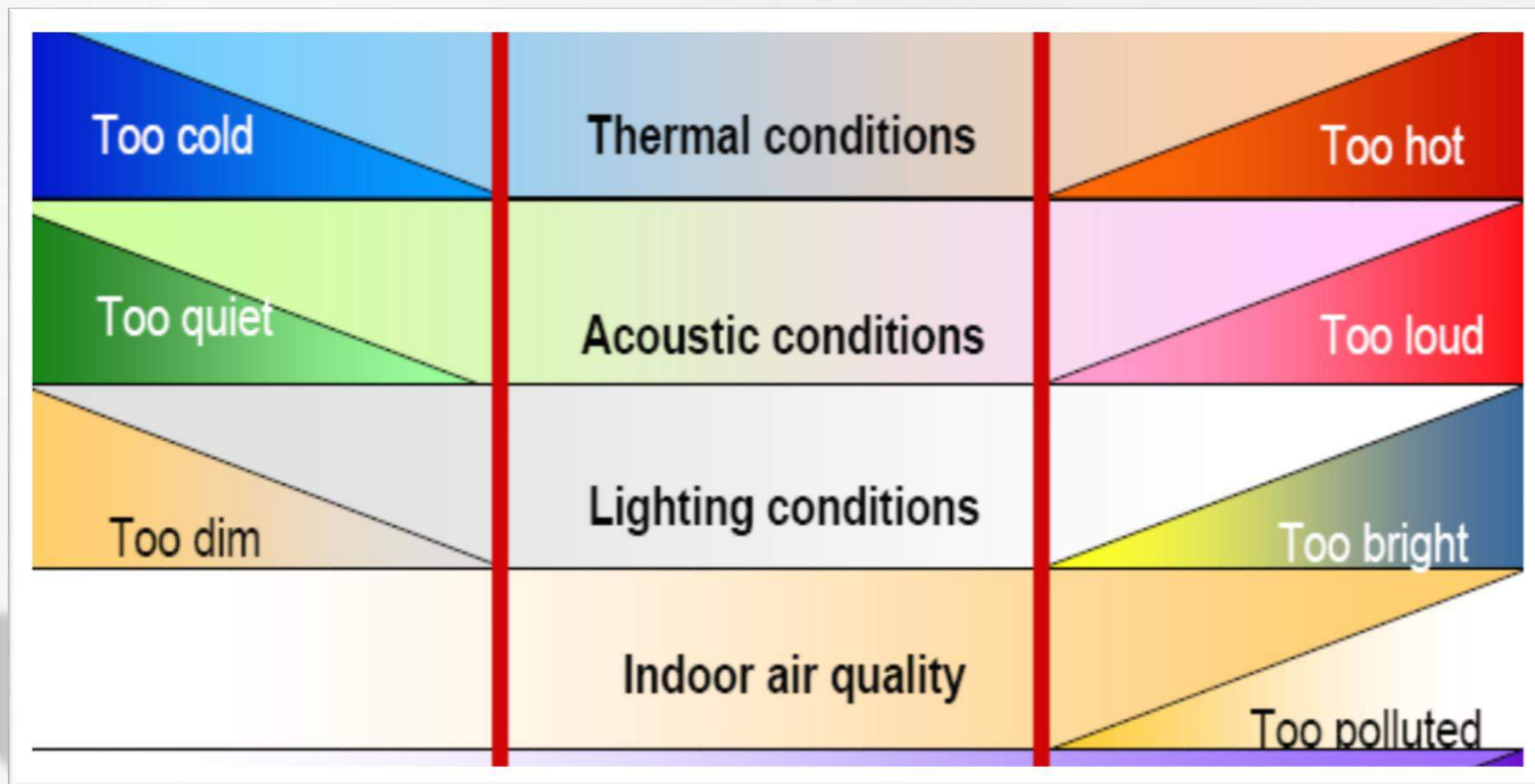
CHPS Technical session: Deep Dive into IEQ, Resiliency and Zero Energy Schools

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CHPS – IEQ ...IAQ Deep Dive Designing Contaminants Out of Healthy, High- Performance



What is INDOOR ENVIRONMENTAL QUALITY



Source: Stanton, Hedge et al. (2004) Handbook of Human Factors and Ergonomics, CRC Press

IEQ Supports CHPS Core Mission

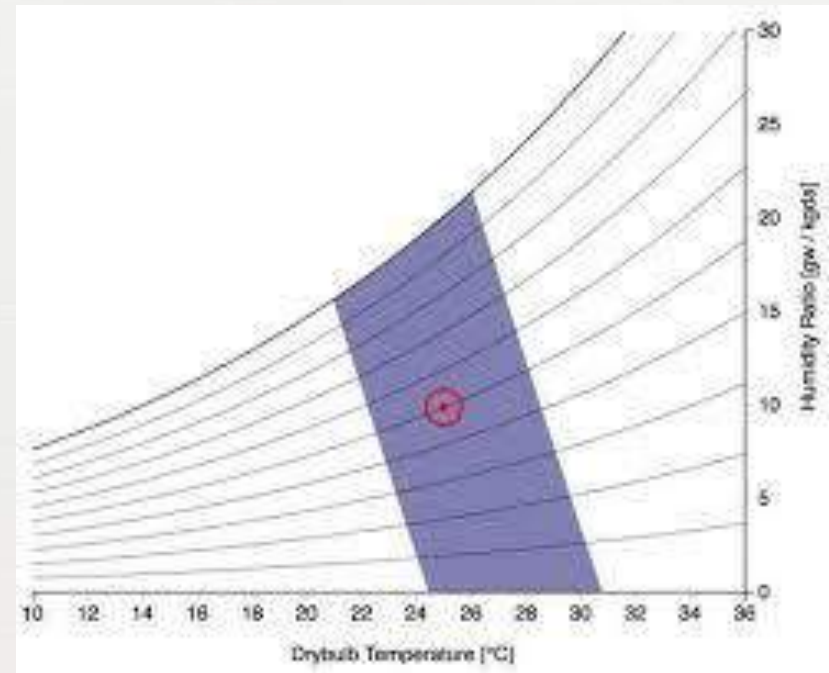
- Improved occupant health
- Improved academic outcomes
- Reduced student absenteeism
- Reduced teacher absenteeism
- Improved teacher retention



Thermal Comfort

Studies on Thermal Comfort and Productivity

- 2% Reduction in Productivity for Every 1° C (1.8° F) Rise Above Comfort Zone
- Lower Temperatures Affect Productivity and Increase Errors



IEQ: ACOUSTICS

- Background Noise
- Reverberation Time
- Sound Isolation
- Verification Protocol



Acoustic Comfort

- Critical to Learning
- Background Noise & Reverberation Rates Affect Speech Intelligibility
- Students in a School in Airport Flight Path Performed up to 20% Lower on Reading Tests



Lighting Quality

- Studies on Lighting Show
 - Quality affects mood, behavior and ability to concentrate
 - Daylighting affects speed and performance on standardized tests
 - Outside views affect occupant's ability to stay focused



IEQ: LIGHTING

Daylighting

- Glare Protection
Prerequisite
- Daylight Availability
 - Multiple Point in Time
 - Spatial Daylight Saturation (sDS) – LM-83
- Classrooms
- Support Spaces



LIGHTING

Electric Lighting Performance

- Color Rendering Index ≥ 80
- RoHS compliant
- LED performance
 - Achieve an initial efficacy of at least 50 lumens/watt
 - Maintain 70% of Initial Light Output after 50,000 hours



Indoor Air Quality (IAQ)

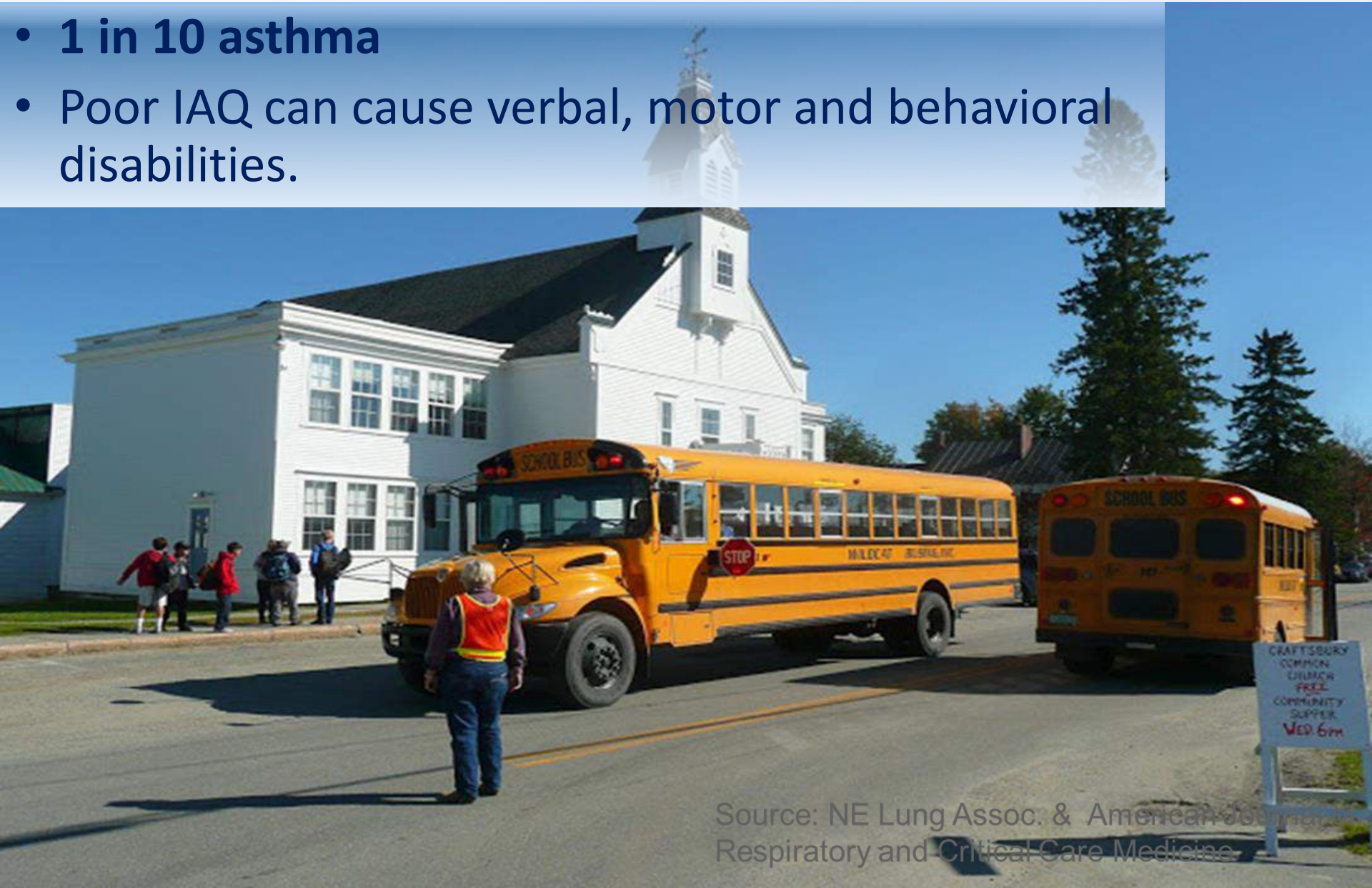
IAQ comprised of:

- Ventilation Rate
- Chemical Contaminant Control
- Biological Contaminant Control
- Particulate Contaminant Control



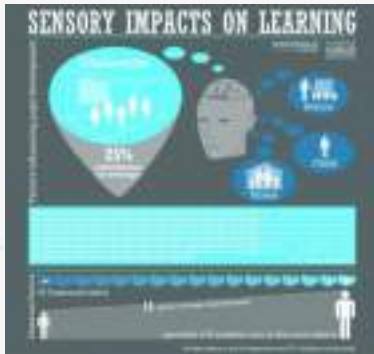
IAQ

- 1 in 10 asthma
- Poor IAQ can cause verbal, motor and behavioral disabilities.



Source: NE Lung Assoc. & American Journal of Respiratory and Critical Care Medicine

“[We have] clear evidence of the significant impact of the built environment on pupils’ learning progression”



Building and Environment

November 2012

“A holistic, multi-level analysis identifying the impact of classroom design on pupils’ learning”

Download: <http://www.sciencedirect.com/science/article/pii/S0360132312002582>

Connecting Conditions to Outcomes



Indoor Air Quality

Healthy Kids Go to School



NE-CHPS CRITERIA

Integration – 8.4%

Operations & Metrics – 9.2%

Design:

- **Indoor Environmental Quality – 31%**
- **Energy – 26%**
- **Water – 8.4%**
- **Site – 8.8%**
- **Materials & Waste Management – 7.6%**



INTEGRATION - SYSTEMS APPROACH

BUILDING SYSTEMS

1. HVAC
2. Lighting
3. Interior Finishes
4. Envelope
5. Site
6. ...
7. ...
8. ...

PROJECT TEAMS

1. Owner
Representatives
2. Design Consultants
3. Construction
Representatives
4. School Occupants

OPERATIONS & METRICS

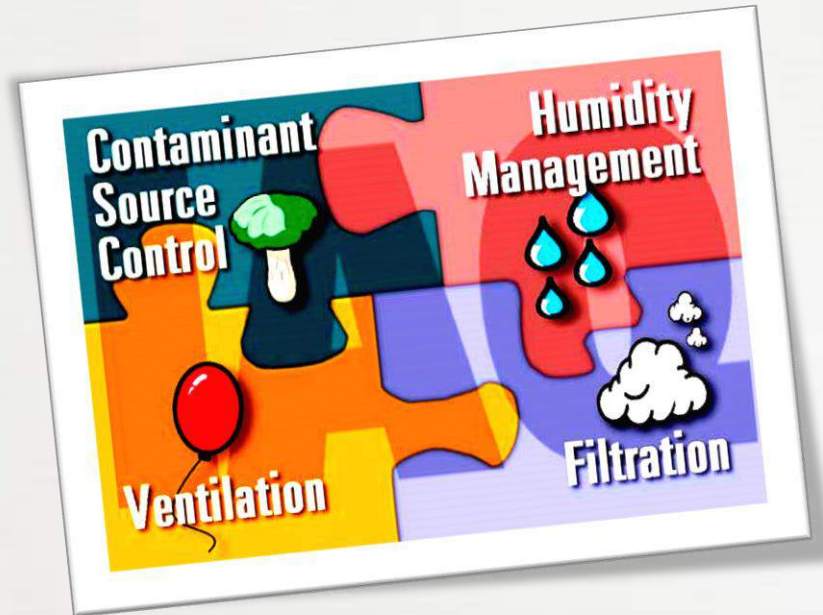
- **Facility Staff & Occupant Training**
- **Systems Maintenance Plan**
- **Indoor Environmental Management Plan**
- **Green Cleaning**
- **Integrated Pest Management**
- **Anti-Idling Measures**
- **Performance Benchmarking beyond Energy – Includes IAQ**



INDOOR ENVIRONMENTAL QUALITY

INDOOR AIR QUALITY

- **HVAC Design** - ASHRAE 62.1
- **HVAC Filtration** – require MERV 13; credit for MERV 15
- **Pollutant Source Control** – Walk-off mats, EPEAT Electronic devices, chemicals storage, CO monitors
- **Moisture Management** – Outdoors, indoors, and in HVAC
- **Construction IAQ Management** – option for IAQ testing
- **Post Construction IAQ** – HEPA filter vacuuming
- **Low Emitting Materials** – PreRequisites for Paints/Coatings, Flooring, and Composite Wood; Addresses VOCs
- **Low Radon**
- **Thermal Comfort** – ASHRAE 55 (incl. RH)
- **Mercury Reduction**



Examples of IAQ Management

- Design
 - Walk-off Mats at Entrances
 - Air Intakes Away from Drop-Offs
- Maintenance
 - Cleaning Chemicals
 - Water Intrusion
- Operations
 - Smoking Areas Away from Doors and Windows
 - Policies on use of Scented Grooming Products



CHPS Programs and Resources

Current offerings

- ▶ *CHPS Best Practices Manual*
- ▶ Project Recognition Programs
- ▶ *Training Opportunities*
- ▶ *School District Program*
- ▶ CHPS Membership
- ▶ PreFab Classrooms Scorecard
- ▶ *Product Database*
- ▶ *Operations Report Card*

Glass &
Plastic Bottles

Drink
cans

PAPER

High Performance Product Database

- Includes Low Emitting Materials other environmental attributes such as EPDS and HPDs
- Help project teams find products that fulfill requirements of CHPS Criteria
- Educate consumers about the environmental impacts of product selection



Conclusions

- **Estimate 80-90% Costs of a Building Associated with Worker Salaries Compared to Only 3% Associated with Owning and Maintaining the Building**
- **Absenteeism and Teacher Attrition Reduce District's Operating Budget**
- **Although the Cost of Green Construction is Perceived to be High, Studies Found No Significant Difference in Cost**
- **Cost Poor Performing Schools to the Society are Significant**
 - Higher Drop-out Rate
 - Higher Poverty Rate
 - Higher Incarceration Rate

QUESTIONS?

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Thank you!