

# Seeing through the Haze: British School of Beijing's Indoor Air Quality Improvement Plan



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THE BRITISH SCHOOL OF BEIJING Shunyi  
A NORD ANGLIA EDUCATION SCHOOL







Alexander Besant | December 5, 2013 17:25

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## Shanghai pollution reaches epic levels, shuts down schools, cancels flights

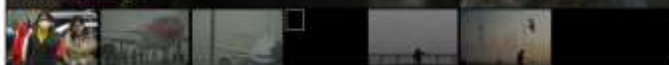
The fog clouded the city's skyline and emptied streets, as pedestrians avoided breathing the thick yellow pollution.

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Women wear face masks on a street in downtown Shanghai as severe pollution hits the city on December 5, 2013.

PHOTO BY Peter Park

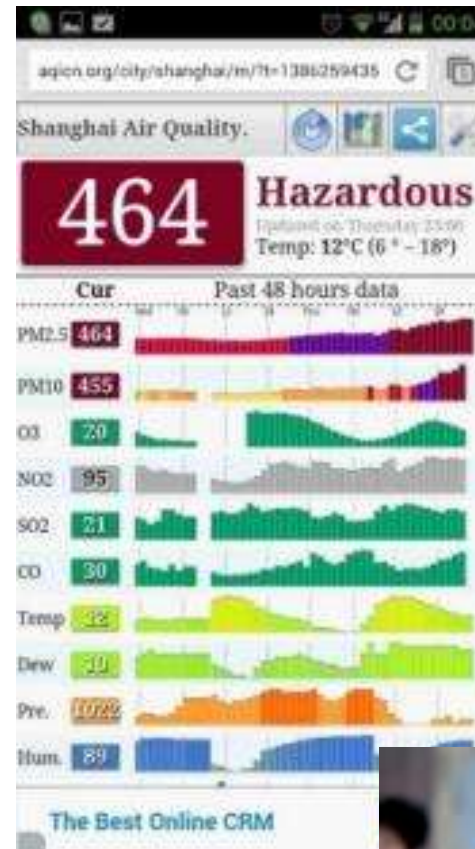


A thick cloud of smog has enveloped Shanghai and other parts of eastern China over the last week, canceling flights and closing schools.

The fog clouded the city's epic skyline and streets emptied, as pedestrians avoided breathing the thick yellow pollution.

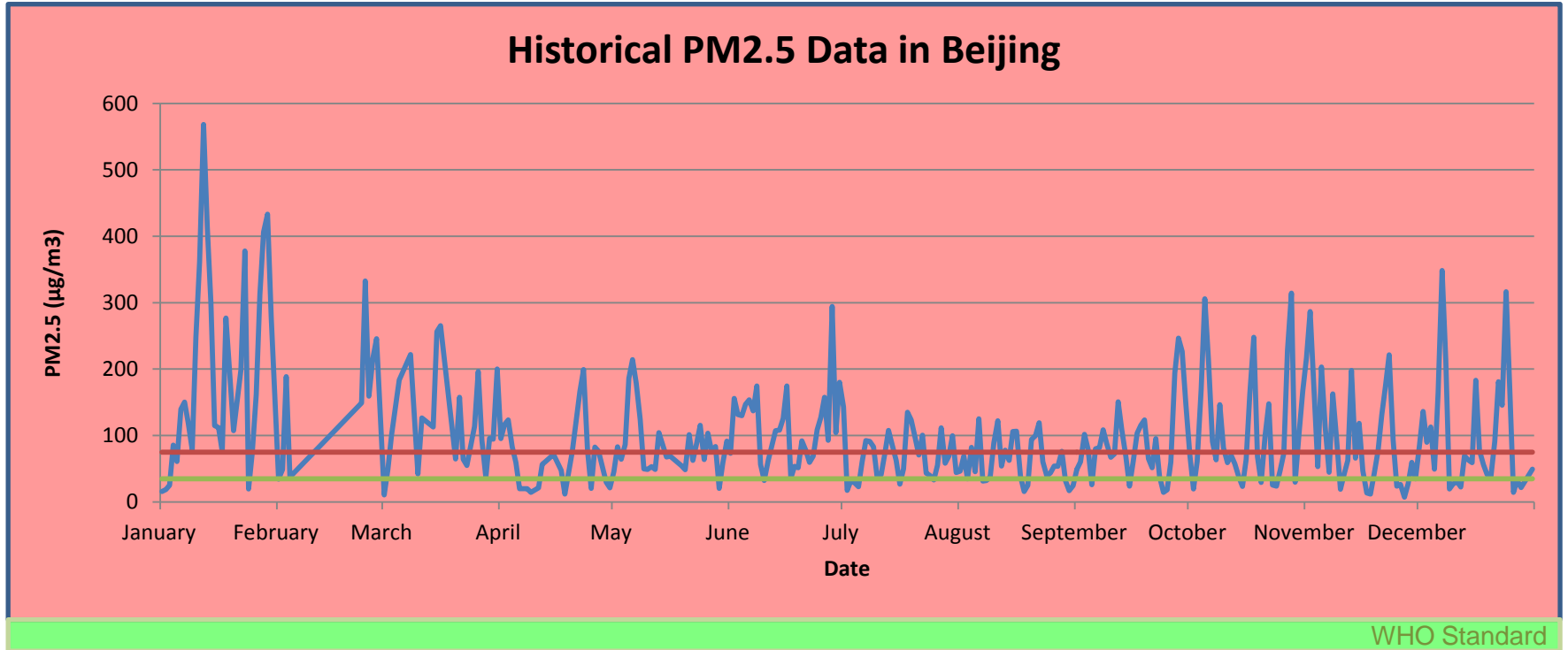
Authorities ordered schools closed on Friday, and called a halt on construction.

They also banned 30 percent of government vehicles from the road, fireworks, and all public sporting events, which could pose safety threats.





# Outdoor air levels in Beijing in 2013



Based on data from US Consulate's Twitter feed

# DEPARTURE



# Agenda

- **Who are we?**
- **What is Indoor Air Quality?**
- **BSB's Indoor Air Quality Strategy**
- **What you can do at home to protect yourself**
- **Frequently Asked Questions / Q&A**

# PureLiving China

- Full Service, indoor environmental testing and consulting (air, water, lead, mold, asbestos)
- Credible and recognized - 2,800+ projects since 2010
- Certified, trustworthy test results with expert interpretation
- International standards and best practices
- Cost effective, proven solutions based on your environmental assessment: remediation, filtration, energy savings, air monitoring





## Our Approach



### Assess

- Certified testing: air, water, mold, chemicals, lead
- Odor investigation
- Energy and building safety auditing

### Fix

- Remediation
- Commercial filtration
- Energy savings
- Green materials sourcing and air quality design

### Maintain

- Monitoring
- Maintenance
- Staff training
- Community engagement

# Environmental Health and Safety Advisors to China's Top Companies and Schools



Over one-third of the Fortune 100 companies in China are our clients

Featured in:



We have also worked with over two dozen schools and universities in Shanghai and Beijing

## What our Clients say



*"When looking at all the options, we choose this path as it provided the right balance of urgency and effectiveness, and **PureLiving has a successful track record within other schools..**"*

-Gregg Pinick, Head of School



5 campuses  
(~50.000sqm)

*"PureLiving was **organized, efficient and professional...**in ensuring our students and their schools are safer and healthier places to learn. **Consulting with PureLiving has been an excellent partnership**"*

-Jeffry Stubbs, Superintendent,  
Shanghai Community International School



*"Your work is **fast, efficient, and cost-effective.** All in all, our whole school community feels...that we are in Pureliving's capable hands."*

-Tom Kline, Director,  
Western International School of Shanghai



*"An enormous "thank you" for many extraordinary things you have done for MSS and the children this past year and half. **We have come to count on you for the services that you provide so professionally and thoroughly.**"*

-Judy Townsend, Head of School

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- Who are we?
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## Why is indoor air quality such an issue in China?

- Lagging regulatory enforcement and lack of mandatory disclosure
- **High levels of outdoor pollution infiltrate into indoors**
- Frequent renovations + poor materials = bad air quality
- We spend up to 90% of our lives indoors. But indoor air is typically 5-10x more polluted than the outdoors
- Children are an at-risk group
- Misinformation about what solutions really work



# Particulate Pollution (PM2.5)

## Sources:

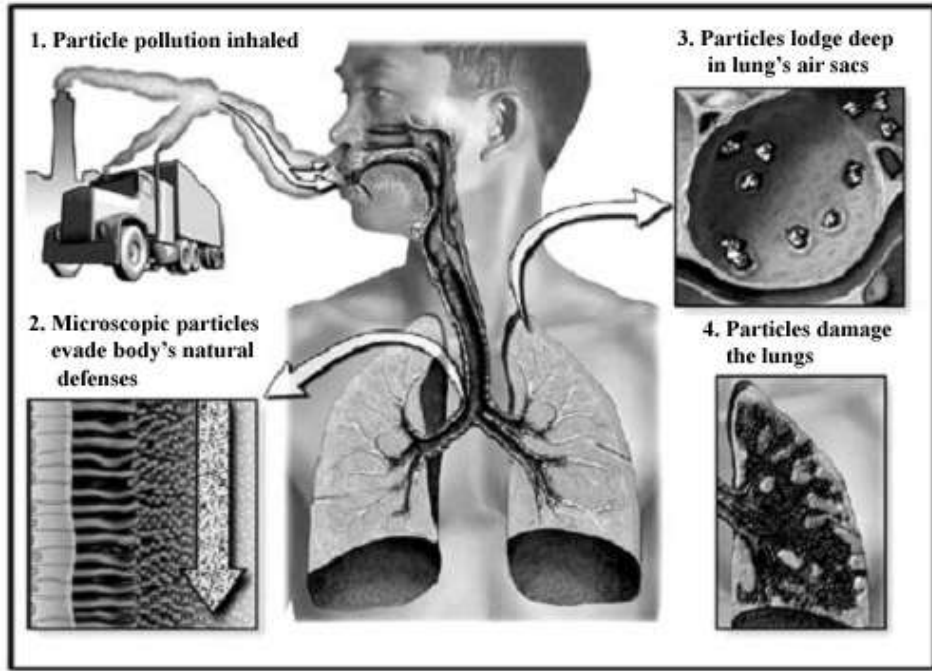
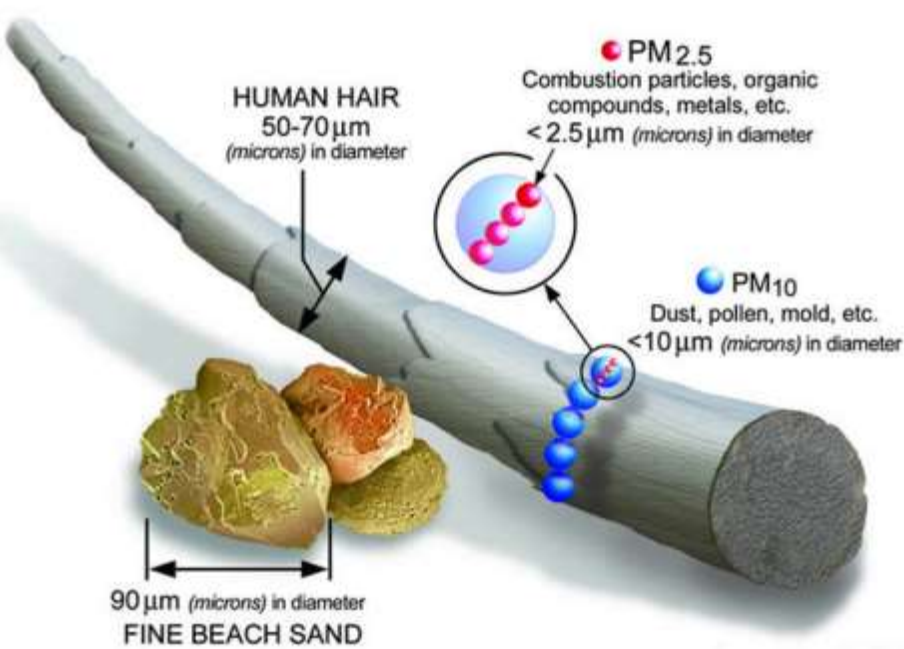
Vehicle exhaust, coal burning, industrial emissions, construction, dust buildup (no proper vacuum)

## Health impact:

Respiratory disease and infection, triggers asthma attacks. Contributes to heart attacks and strokes, diabetes, and even obesity



# Even though you don't see or smell it, PM2.5 damages your lungs



# AQI vs. API vs. Mass Concentration

## AQI (Air Quality Index)

- Unitless scale between 0-500 that US EPA uses to describe pollution level
- Normally composed of multiple pollutants: PM10, PM2.5, NO<sub>x</sub>, SO<sub>2</sub>, ozone
- AQI will show the highest pollutant, so AQI can be high even if PM2.5 is low
- Not linear – API of 200 is about 4x worse than 100

## API (Air Pollution Index)

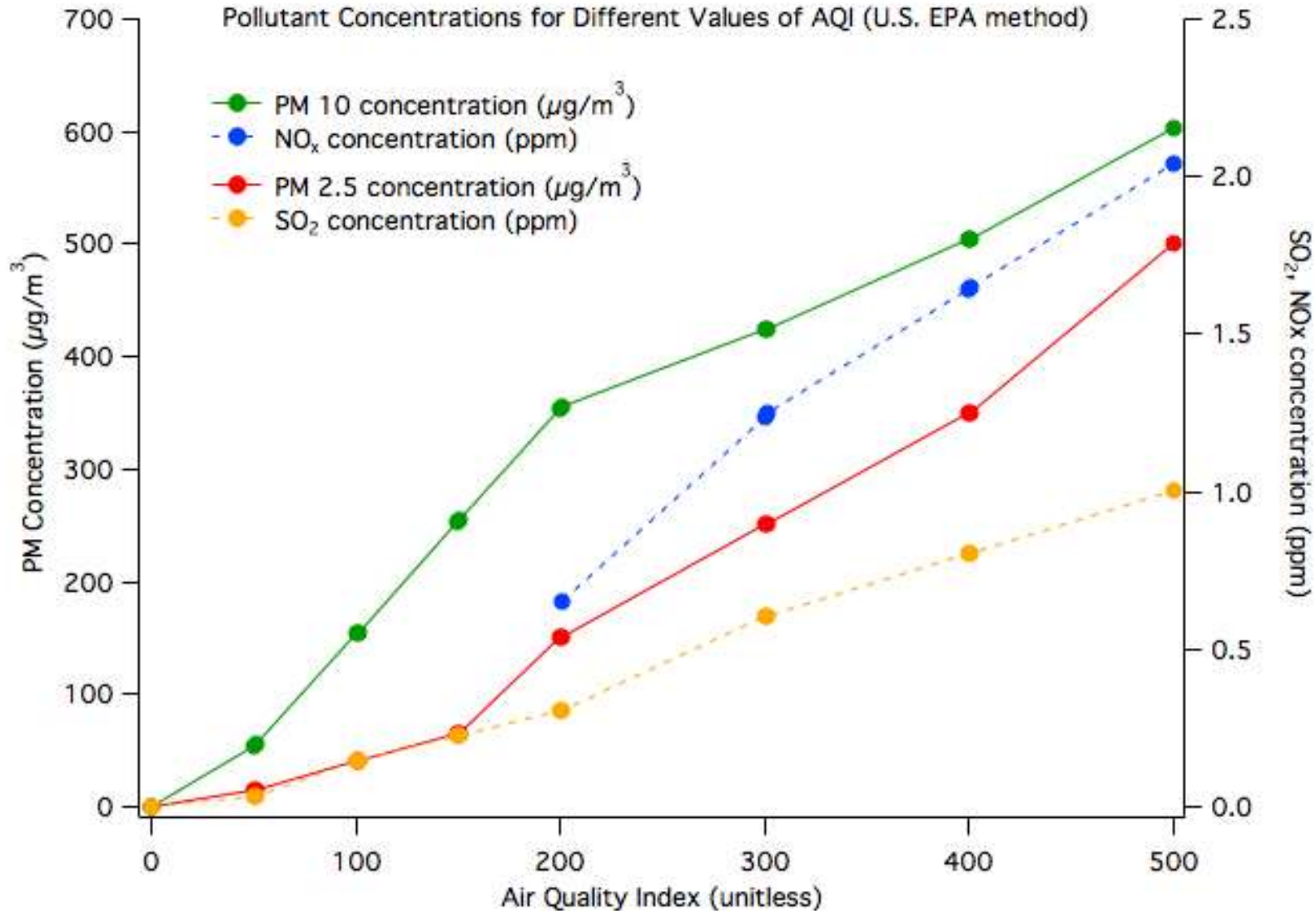
- Unitless scale between 0-500 that China MEP uses to describe pollution level
- Different concentration levels between API/AQI 0-200. API 50 = AQI 100
- Same above API/AQI > 200

## Mass Concentration (micrograms per cubic meter or $\mu\text{g}/\text{m}^3$ )

- Amount of dust that is in a volume ( $\text{m}^3$ )
- All health standards use mass concentration
- Allows you to compare numbers regardless of country or equipment type
- We recommend US EPA of  $35 \mu\text{g}/\text{m}^3$  (WHO = 25, China = 75)
- Recommended option for policy formulation



# AQI vs. API vs. Mass Concentration



# Volatile organic compounds (VOCs)

## What:

Class of organic chemicals slowly emitted from manufactured materials

## Sources :

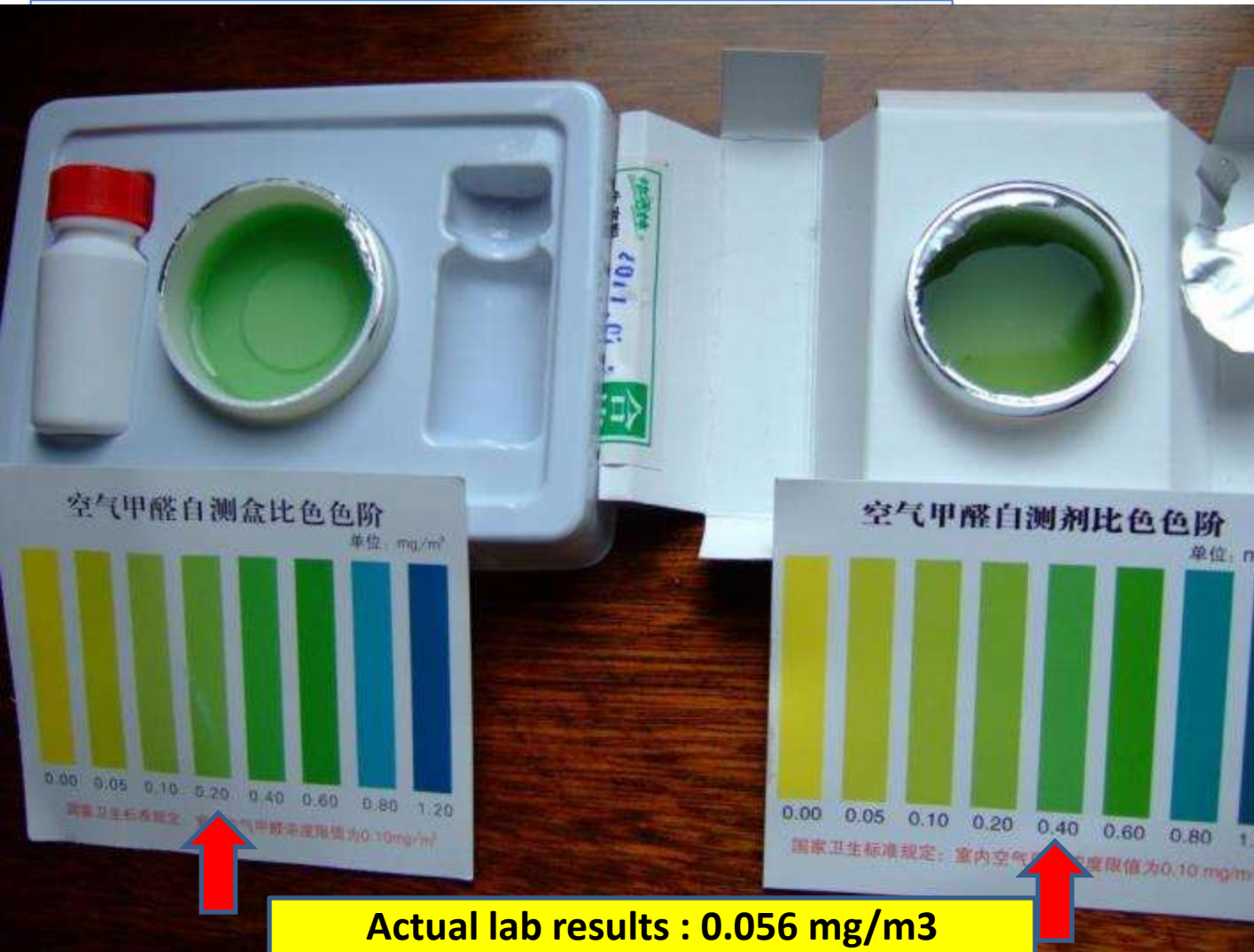
Extremely common in building materials: particle board, glues, paints, carpet backing

## Health :

Causes headaches, rashes, nausea, vomiting, nose bleeding, or eye, nose, or throat irritation. Linked to nasal cancer



# Not a solution!



Self-testing kits are notoriously inaccurate and misleading

**Actual lab results : 0.056 mg/m<sup>3</sup>**  
Left kit : 0.2 mg/m<sup>3</sup> (350% over)  
Right kit : 0.4 mg/m<sup>3</sup> (650% over)

# Microbials: Mold and Bacteria



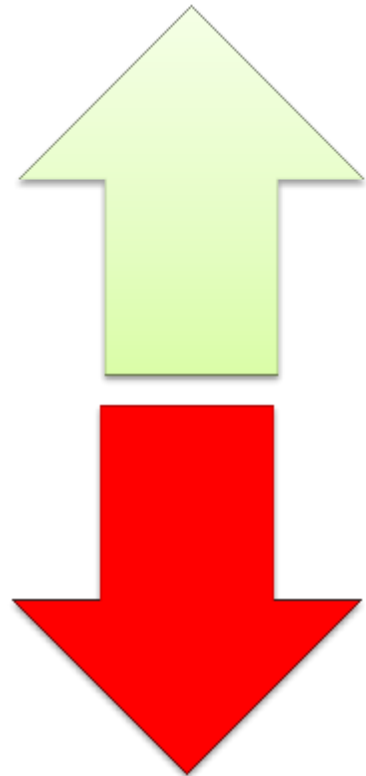
**Sources:** humidity, water damage, low ventilation, cross-contamination

**Health impact:** allergic reactions, asthma development, runny nose, headaches, some molds can release toxins. Long term exposure → mold allergies

# Lead Exposure: China-specific problems

*“Even in areas with no lead pollution sources, over one-third of Beijing children tested positive for lead poisoning compared to 3% in the US.”*

Review of decade of lead studies pub by Environmental Research



- \* Leaded gas and paint banned
- \* New construction means little likelihood of old leaded paint
- \* Few laws limiting use in domestic manufacturing
- \* Landlords not required to delead/test
- \* Standards are lower (air and blood)



- 1. Identify sources in your environment**
- 2. If levels are high, test blood to confirm**
- 3. Eliminate sources and reduce exposure**

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## Client situation

- Out of concern for the health of students and staff, the British School of Beijing conducted a systematic air quality audit for its Beijing campus by PureLiving China, a leading indoor environmental consulting firm in China in November 2013.
- To better protect its students and staff, BSB has upgraded its facility by installing the customized in-ceiling air filtration systems throughout its campus, as well as installing high-efficiency air filters in the fresh air systems.
- Next, state-of-the-art online Air Quality Monitors will be available to safeguard the health and safety of everyone on campus.

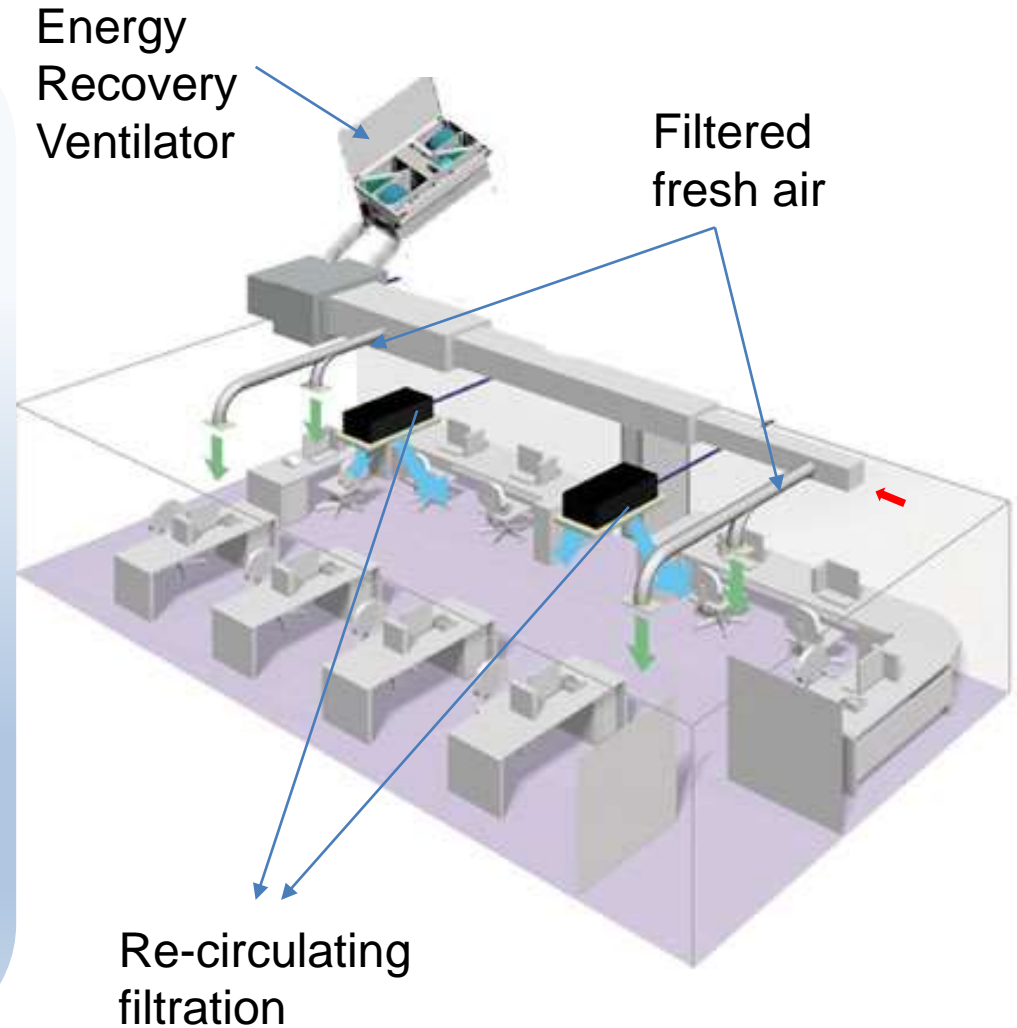
### Objectives:

- ✓ Provide confidence and peace of mind to parents, students and staff
- ✓ Market differentiator
- ✓ **Target: WHO air quality =  $<35 \text{ ug/m}^3$**

# The Total Solution

Indoor air quality incorporates these five principles:

1. Fresh outside air
2. Filtration of incoming fresh air
3. Re-circulation filtration
4. Energy recovery
5. Monitoring and maintenance





# Solution – Filtration

## Common Ways of filtration

**Portable Filters**



**Ceiling mounted – Duct type air purifier (Exclusive technology)**



**In-duct Filtration**



**Central AHU Filtration**



# XJM Re-circulating Air Cleaner Exclusive Technology

- Custom design suited to specific locations
- Single unit can filter up to 100m<sup>2</sup>
- Will achieve more air changes per hour
- Discreet and hidden from view
- Can be controlled remotely via web interface

## Pros

- Typically more effective and faster to reduce PM than portables
- Can accommodate large volumes
- Price-effective
- Allows for other pollution reduction technology
- Frees up floor space
- Safer

## Cons

- Not portable
- Permanent



# In-duct Filtration & Central AHU Filtration For Large Space

Install inside the HVAC system in order to filter all air which enter the ACs.

## Pros

- Custom size
- Faster
- Effective
- Larger application area
- Cost-effective
- Frees up floor space
- Won't change exterior of site
- Safer – won't be tough and hidden from user
- Long life

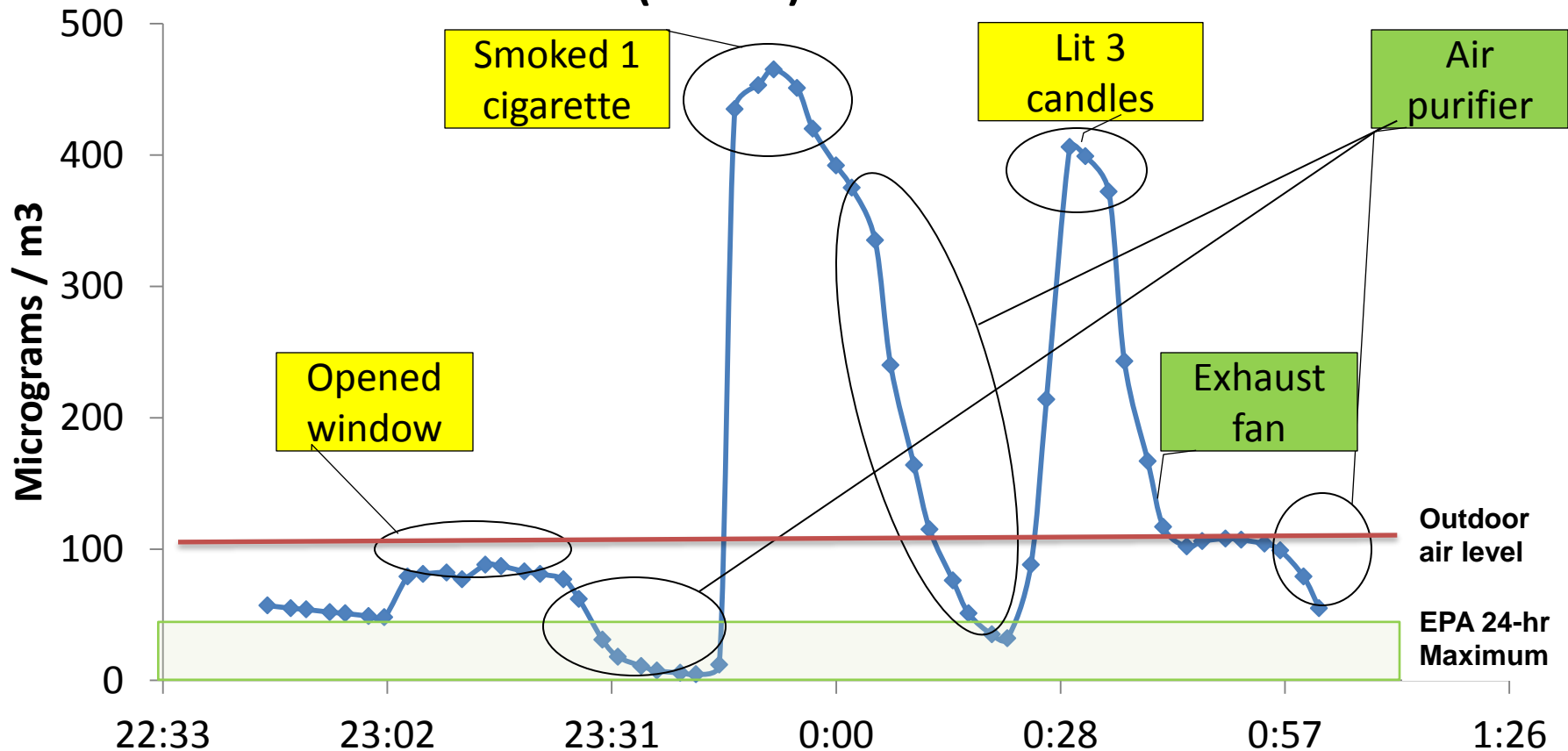
## Cons

- Not portable
- Can not be reused
- Reduce a little air volume of FCUs
- A small increase in the risk of condensation ( only in cooling)



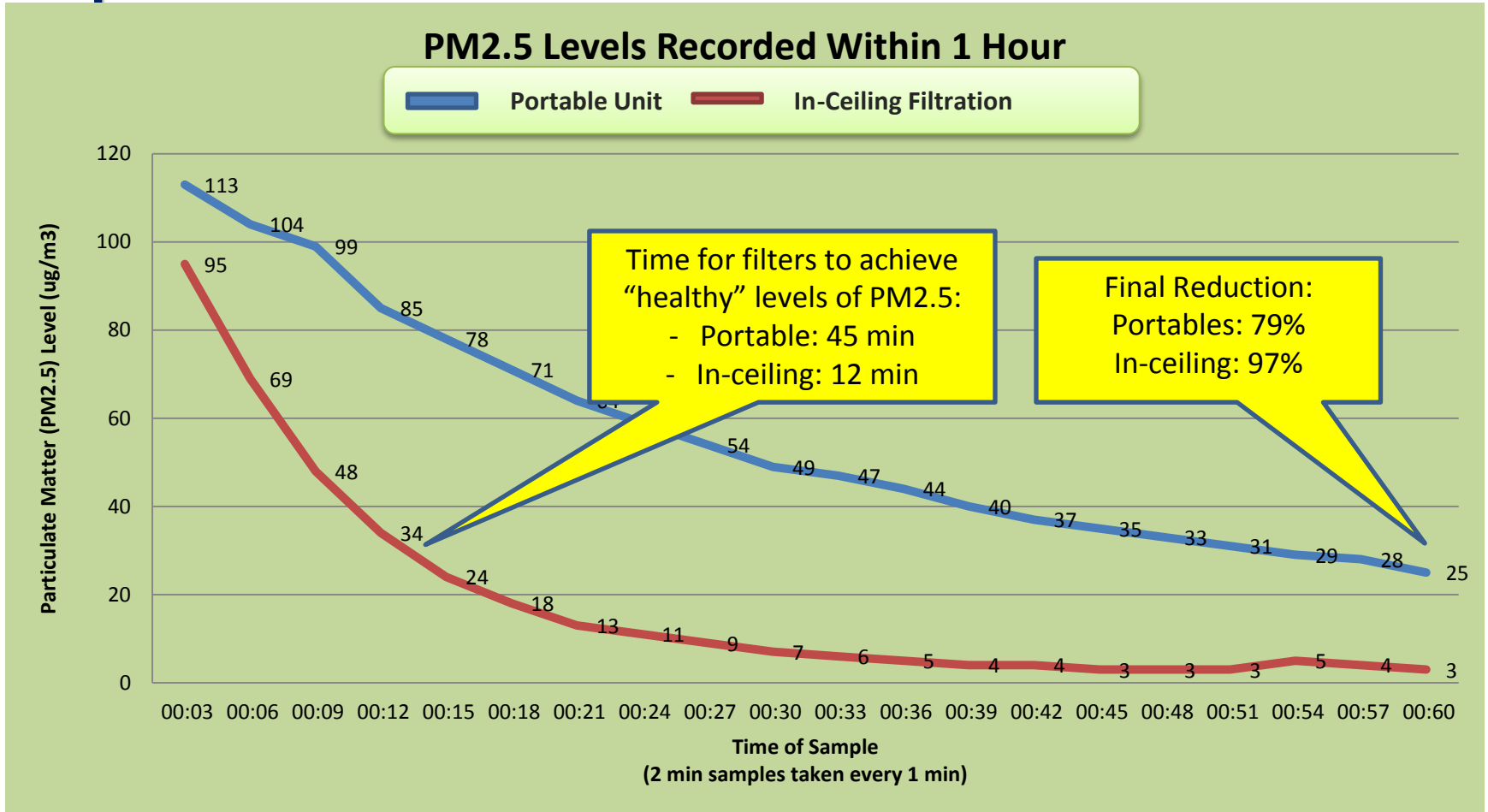
# Do Air Filters Work?

## Particulate Matter (PM2.5) Concentration over Time



1. Occupant activities really impact air
2. Air purifiers do really work!

# However, in-ceiling fixed purifiers are much more effective than portable units



**The ceiling-mounted unit works faster and is more effective than a portable unit**

# Real-Time IAQ Monitor

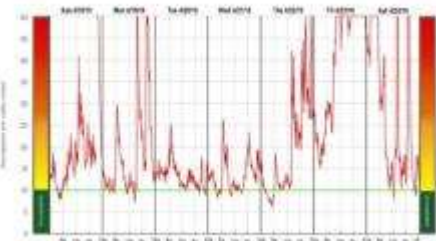
Provides real time display of common IAQ parameters:

- Particulates (PM2.5)
- TVOC's (total organic volatile compounds)
- Carbon monoxide
- Carbon dioxide (ventilation quality)
- Temperature and relative humidity



## Mobile Reporting

- The IAQ Monitor unit will be visible but the data will **not be shown to the staff, unless management decides to publish**
- The data can be used to **monitor the effectiveness of filtration** system set up in the campus
- Enables operation/facility managers to **maximize air quality** over the long term with **automatically generated job tickets**



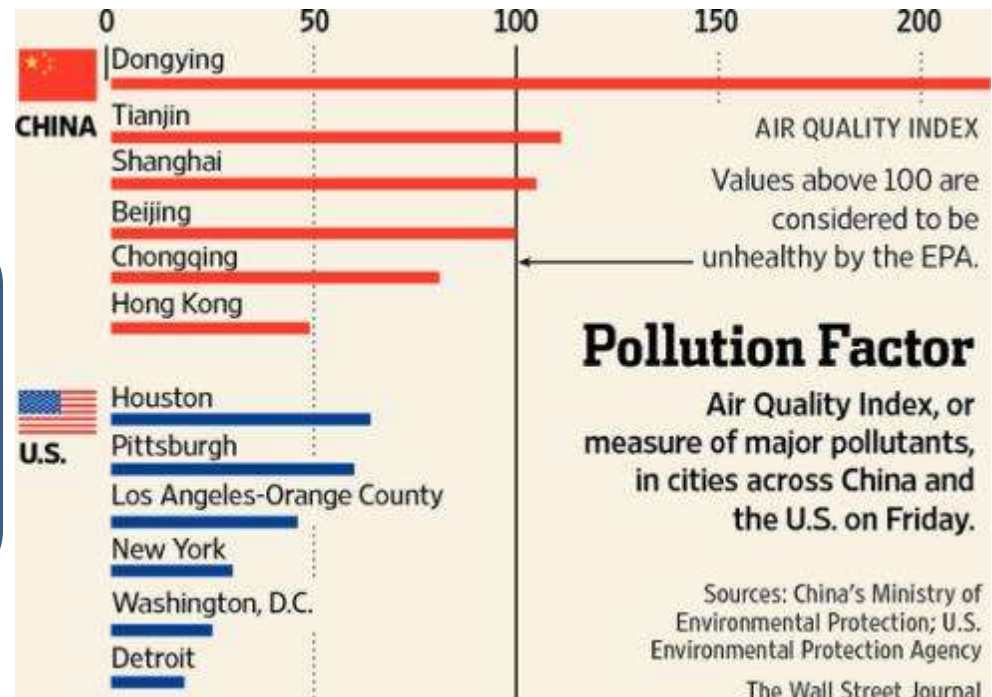
# Expected Results of Good Air Quality Will be Significant

Average productivity gain due to good indoor air quality (IAQ) is between 3-7% -- 100 hours per worker each year

Students in classrooms with better ventilation are on average 15% more productive

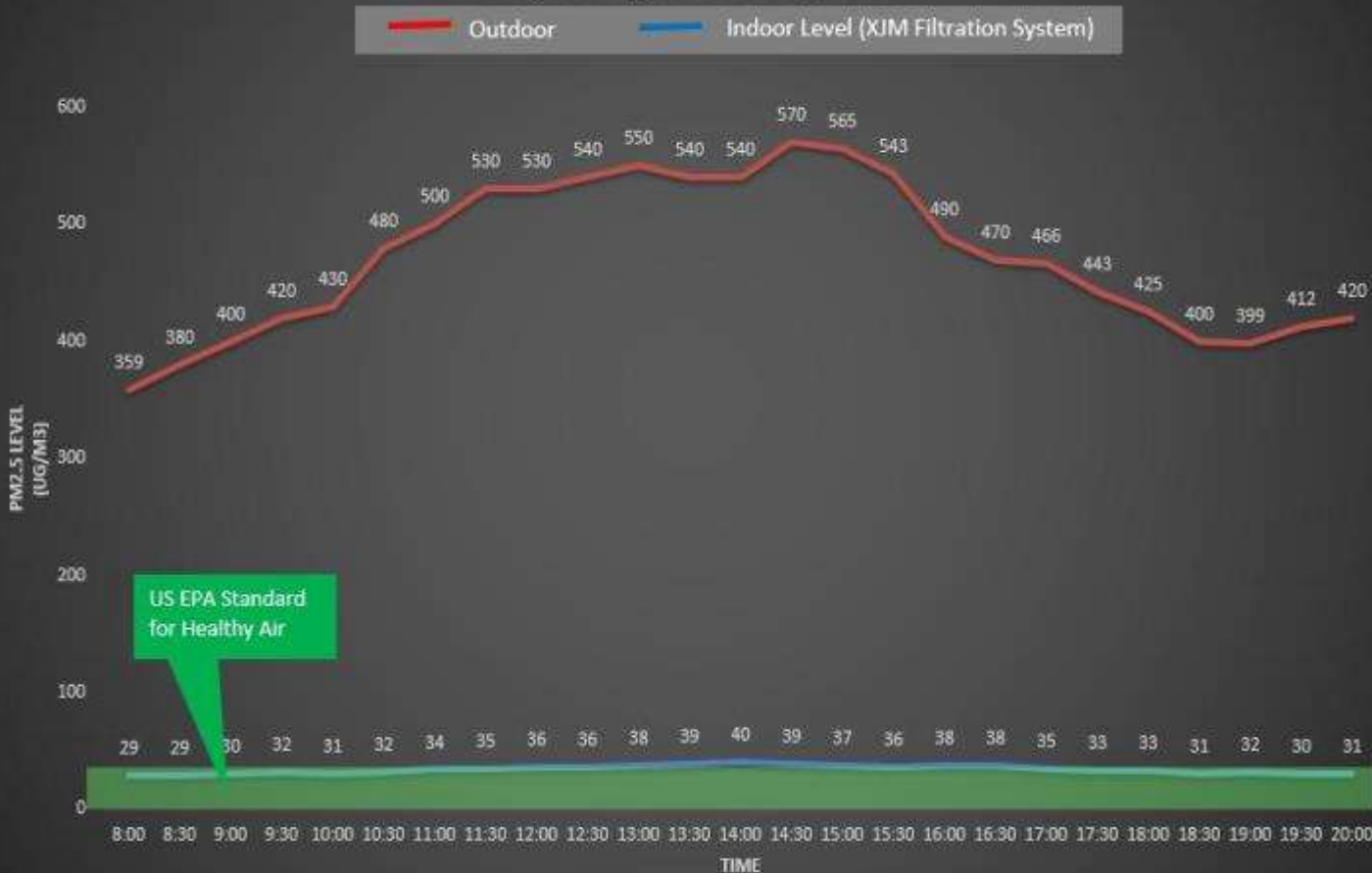


Improved air quality can reduce absenteeism by 35%



# Filtration Systems will stop outdoor pollution cold: XJM System performance during Shanghai Airpocalypse

Comparison of Outdoor and Indoor Pollution Levels During Shanghai "Airpocalypse" Dec 6, 2014



- Data sampled under worst case situation (12/6/13)
- Outdoor levels during 12 hr workday averaged 472 ug/m3 – over 12x the US EPA’s standard for healthy air (35 ug/m3)
- Meanwhile, indoor levels averaged 34 ug/m3, within the US EPA’s standard
- **System reduced PM levels 93%**

**Guaranteed to meet or exceed the US EPA standard of <35ug/m3**



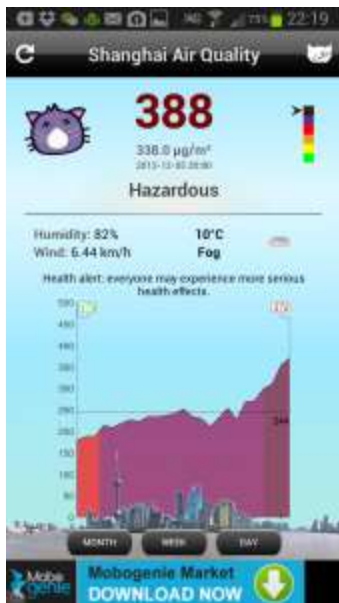
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# Knowledge is power

## Outdoor Air Quality online sites

- Website: [www.aqicn.info](http://www.aqicn.info)
- iPhone: China AQI (Fresh Ideas Studios)
- Android: China AQI, Shanghai Air Quality
- ***Plans to setup local outdoor monitoring stations. Stay tuned...***



## Modify Your Behavior Based on Air Quality

- Magic number: **<35  $\mu\text{g}/\text{m}^3$**  (US EPA)
- Don't open windows if **> 140  $\mu\text{g}/\text{m}^3$**
- Wear masks **> 70  $\mu\text{g}/\text{m}^3$**
- Okay to have windows open if **<35  $\mu\text{g}/\text{m}^3$**

# Arm Yourself - Equipment



## Use air purifiers

- Must fit the room – be aware of sizing
- Turn on high speed for 1 hr before going to bed or after ventilating
- Set to medium when home; low speed ineffective
- Change filters based on manufacturer guidance or when dirty

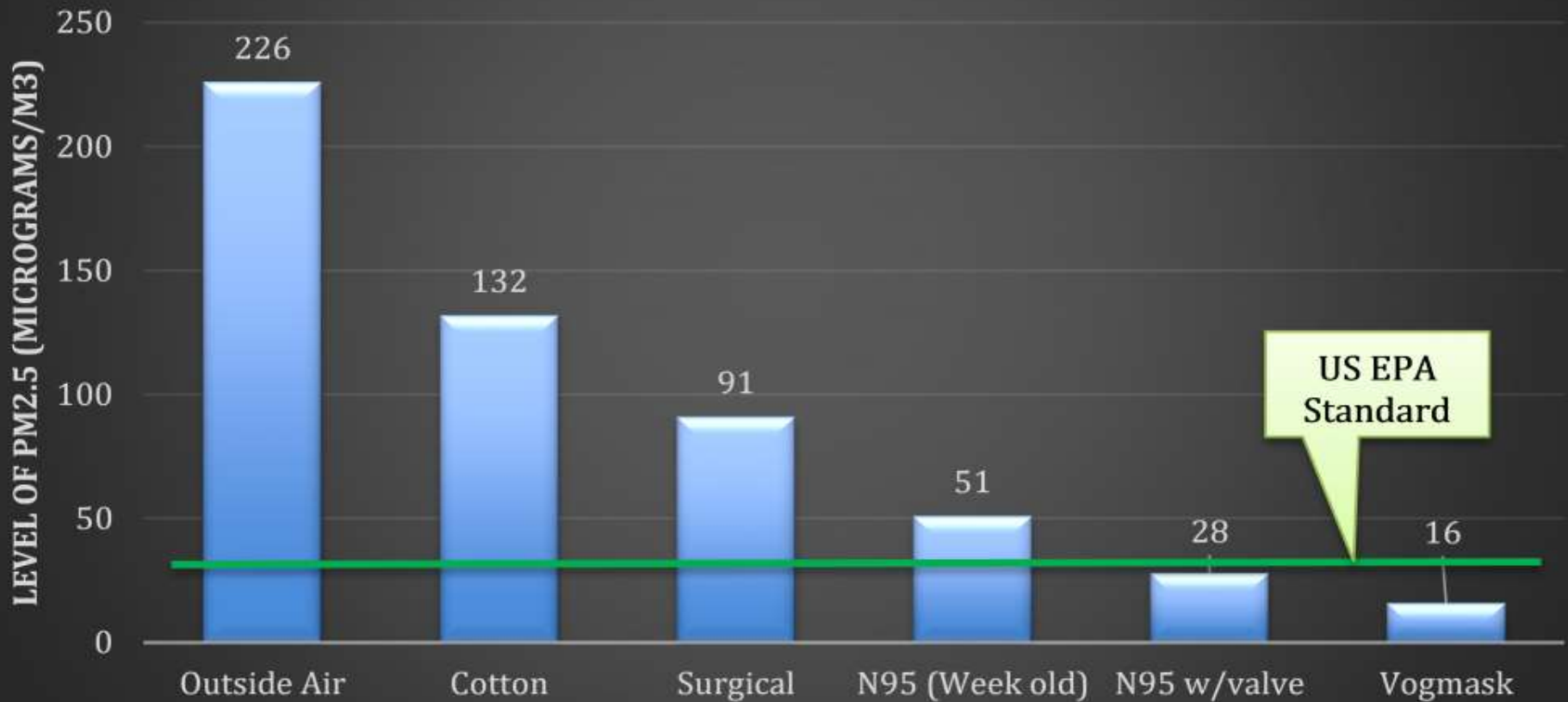


## Use HEPA vacuums to control dust

- New vacuums have special filter to collect dust
- Before, all the outdoor dust was settling and then becoming airborne in classrooms
- Vacuum rugs, carpets, fabrics – anything that is not easily mopped
- **At least once per week**

# Do masks work?

## Mask Efficiency at Reducing PM2.5 Intake



The PM2.5 concentration was measured with a Lighthouse 3016-IAQ. The numbers shown above are the calculated average of two separate samples. Testing was performed on February 21st, 2013 at 6:00pm around East Third Ring Rd, Beijing.

# What you can do



## Keep doors and windows closed!

- However, still ventilate once or twice a day for 20 min each time
- Monitor free air quality monitoring station data
- Close windows, turn on purifiers



## Avoid humidifiers

- Indoor humidity should be 30-55%
- **Most people use humidifiers without knowing what the level is**
- High humidity → mold and allergens
- Office mold often found caused by humidity

## What you can do

Use a good HEPA-filtered vacuum cleaner to ensure that settled dust doesn't get released back into air. Once a week – all surfaces that can hold settled dust



# What you can do

## Replace filters frequently:

- Every 6 months in air purifiers
- When dirty in vacuums



# Not all about PM2.5...

## Ten Tips for Choosing a Healthy Home

1. Avoid basements
2. Avoid new construction and new furniture
3. Avoid carpets (haven for particulate and allergens)
4. Check for water damage or leaks from outside
5. Beware odors – especially musty ones
6. Proper insulated windows and basement (no condensation)
7. Ask site history – chemicals persist in soil for decades
8. Choose lead-free, low-VOC paint (<50g/L)
9. Insist on an exit lease clause pending air testing
10. Get your new home tested – it's better to know!



# Our goal is to be a true partner to the community

## Community announcements posted by partner schools



committed to a viable indoor air quality solution

*...and making a safer and better place for learning.*



"SCIS is one of the most progressive and proactive schools we have worked with. They have implemented a multi-phased plan to assess the indoor environmental quality, provide improvements, and monitor student-learning environments. SCIS has also taken the lead to educate their school community and share strategies with other international schools."  
Louie Cheng, President, PureLiving China  
SCIS Indoor Air Quality Standard © -50 US EPA Air Quality Index



PURELIVING  
Indoor Environmental Solutions  
www.purelivingchina.com



## Intranet at WISS

Home News College Counselling Photos WISS Sites Calendar

Home > News > WISS Today > Big Dreams for Blue Skies

### Big Dreams for Blue Skies

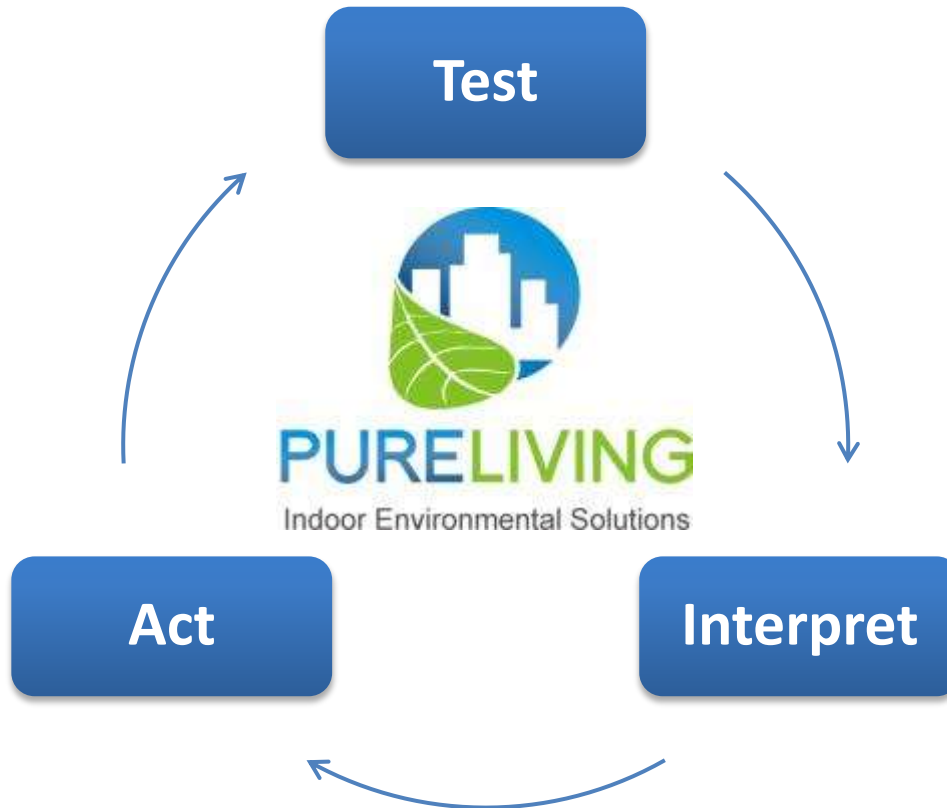
When the pollution levels skyrocketed on December 6th, it gave many people a scare. We have heard so many horror stories coming out of Beijing about the unfathomable, enclosing, encroaching pollution and we thanked the stars, our bosses, our partners, our luck that we were in a city not quite so bad. However, the pollution of that day, put us right up there with our downcast, northern-sister city.

Why did it rise to those levels? And will it happen again? Are the questions we were left with.

We invited Louie Cheng, the President of PureLiving, and our environmental consultant, to come to WISS and answer these questions, and more.

"The reason why the pollution peaked also had to do with the weather at that time, that created a bubble, trapping the pollution in. The bulk of the pollution mainly came from big industry. As the temperatures and the weather changed, the pollution levels dropped. We do not expect Shanghai to be hitting such high-levels or even levels over 200 for extended periods of time."

And immediately, we feel a little relief. But what about the prevailing pollution issue that is now even more of a concern to us all? My children are being kept inside, on account of pollution.



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