Clean Air in Cities: ‘Out’ and ‘In’
National Clean Air Day 2017

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Lead sponsor since 2011
Clean Air in Cities – ‘Out’ and ‘In’

1. Context
2. ‘Out’ – air pollution and greenhouse gases
3. ‘In’ – inside and outside sources
4. Include indoor air quality in new London Plan

Improving indoor air quality is the quickest and cheapest way to protect people
1. Context

• It’s a great time to be an air pollution campaigner!
• Great Smog 1952 and Clean Air Act 1956
• ‘Cohort studies’ identified long-term effects of PM$_{2.5}$
• Myopic focus in UK since 1990 on CO$_2$ and fuel efficiency
• Many roads in Central London tend (today) to have the highest NO$_2$ concentrations in the world. Blame diesel
• Need to protect ourselves and reduce air pollution
• Back where we thought we were 60 years ago
• 61$^{st}$ anniversary of first Clean Air Act on 5 July 2017
2. ‘Out’ on 15 March 2012
2. ‘Out’ – Jargon

- Particles ($\text{PM}_{1}$, $\text{PM}_{2.5}$, $\text{PM}_{10}$) and gases ($\text{NO}_2$). Ozone ($\text{O}_3$)
- Short (e.g. $\text{PM}_{10}$) and long-term (e.g. $\text{PM}_{2.5}$) health effects. Mortality and morbidity. Overlapping effects
- Emissions and concentrations. Exposures, impacts and outcomes. Visible and invisible
- All affected. Up to 9,400 attributable deaths in London (3,500 $\text{PM}_{2.5}$ and 5,900 $\text{NO}_2$) versus 8,500 from smoking. Mainly cardiovascular. Biggest environmental risk
- Local ($\text{NO}_2$), regional ($\text{PM}_{2.5}$) and transboundary pollution e.g. tropospheric ozone ($\text{O}_3$)
2. ‘Out’ – Huge changes in the last 5 years

- Scientific evidence is overwhelming
- Public understanding is rocketing. Over half of Londoners want a diesel ban in central London
- Ongoing media campaigns e.g. ES, Guardian, ST
- National political attention e.g. PMQs
- New legal cases. ClientEarth on NO$_2$. Ella Kissi-Debrah
- New Mayor – ‘Top 3’ issue in the election
- Interventions by UN (e.g. SDGs), WHA, WHO, UNEP
Examples of media coverage

2. ‘Out’ – Pollution challenges

NO₂ annual mean concentrations in 2020 (µg/m³)

Legal limit
2. ‘Out’ – Protect yourself (26 March 2012)
2. ‘Out’ – Protect yourself

Graph by King’s College London
2. ‘Out’ – Protect yourself (City Air app)
2. ‘Out’ – Priorities

• ‘One Atmosphere’ – seek win-win for greenhouse gases and local air pollution
• Integrate policies e.g. air, energy and transport
• Mitigation – reduce emissions at source
• Adaptation – protect people e.g. route choice
• Diesel. Diesel. Diesel.
• Building emissions: efficiency, on-site energy; and renewables
• Achieve zero local and then zero total emissions
• Government strategy. Clean Air Act. Less bad – more good
3. ‘In’ – Inside and out on 19 February 2013
3. ‘In’ – Jargon

- European citizens spend on average over 90% of their time indoors.
- 75% or more of the health impact of outdoor or ‘ambient’ air pollution can therefore occur indoors (Source: EnVIE 2010 p82).
- Indoor concentrations of some pollutants can be much higher than outdoor (e.g. 10 or 20 times higher in the case of formaldehyde).
- We can use air filters to protect ourselves from 90% of air pollutants for up to 90% of the time.
- British and European standard BS:EN 13779 (2012) specifies the required filter performance for good indoor air quality in non-residential buildings taking into consideration outdoor air quality.
- ISO 16890 ePM$_1$ and ISO 10121 address particles and gases.
- Second hand smoke (ETS) is still an issue e.g. children in homes.
**Relative size of particles**

- **Human hair**: 70 µm
- **Pollen**: 20-100 µm
- **Spores**: 3-50 µm
- **Airborne particles**: < 1 µm
3. ‘In’ – Huge changes in the last 5 years

• Scientific evidence is overwhelming e.g. WHO
• Clean Air in London’s investigations
  – local authorities don’t know if their schools use air filters
  – few hospitals comply with indoor air standards
• Environmental Audit Committee warned on schools
• Planning approvals in London are setting indoor standards – but still linked to WHO guidelines!
• New study links office performance to air pollution
• More focus on correlations between NO₂ and PM₁
3. ‘In’ – Pollution challenges

Photo of soot particles in lung tissue
Photo: Lennart Nilsson

A white blood corpuscle from the body’s immune system (blue) tries to attack a soot particle and consume it
Photo: Lennart Nilsson
3. ‘In’ – Protect yourself

*Particle filters with different efficiency*

Outside air

Source: Camfil
Gas filters – activated carbon/charcoal

Key issues include:
• Charcoal’s ability to retain gas molecules on their surface
• This capacity varies for different gases and charcoal quality
• Gas concentration
• Contact time

Source: Camfil
## Air filter groups and classes

<table>
<thead>
<tr>
<th>Group</th>
<th>Filter class (example of use)</th>
<th>Example of use</th>
<th>Average collection efficiency for the most penetrating particle size (MPPS) %</th>
<th>Average efficiency for 0.4 µm particles %</th>
<th>Average arrestance of dust %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>G4</td>
<td>Warehouses</td>
<td></td>
<td></td>
<td>Over 90</td>
</tr>
<tr>
<td>Medium</td>
<td>M5</td>
<td>Protection of ventilation systems</td>
<td></td>
<td>40-59</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M6</td>
<td></td>
<td></td>
<td>60-79</td>
<td></td>
</tr>
<tr>
<td>Fine</td>
<td>F7</td>
<td>Schools</td>
<td></td>
<td>80-89 (min 35)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F8</td>
<td>Laboratories</td>
<td></td>
<td>90-94 (min 55)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F9</td>
<td>Healthcare</td>
<td></td>
<td>95 and above (min 70)</td>
<td></td>
</tr>
<tr>
<td>Efficiency particulate filters</td>
<td>E10</td>
<td>Precision tooling</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E11</td>
<td></td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E12</td>
<td></td>
<td>99.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High efficiency particulate filters</td>
<td>H13 and H14</td>
<td>Operating theatres</td>
<td>Over 99.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultra low penetration air filters</td>
<td>U15, U16 and U17</td>
<td>Space craft</td>
<td>Over 99.9995</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
British and European standard BS:EN 13779
Since April 2007 for non-residential buildings

<table>
<thead>
<tr>
<th>Outdoor Air Quality (ODA)</th>
<th>Indoor Air Quality (IDA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IDA 1 (High)</td>
</tr>
<tr>
<td>Increasing pollution</td>
<td></td>
</tr>
<tr>
<td>ODA 1 eg countryside</td>
<td>F9</td>
</tr>
<tr>
<td>ODA 2 eg smaller towns</td>
<td>F7 + F9</td>
</tr>
<tr>
<td>ODA 3 eg city centres</td>
<td>F7 + GF + F9</td>
</tr>
</tbody>
</table>

GF = Gas filter (carbon filter) and/or chemical filter.
Table based on appendix A.3 “Use of air filters” in European standard BS:EN 13779
Home office test – City S unit
Over 25 minutes
Range 0.3 to 5 microns
97% - 98%
Particle number reduction
3. Current and prospective IAQ standards

Renewed focus on building regulations and ‘duties’

- Building Regulations (2010 and 2013) Part F – NO₂
- Air conditioning TM 44 inspections
- ISO 10121 – Molecular filtration performance
- ISO 16890 ePM₁ rated combination air filters control particles and molecular contaminants for optimum indoor air quality. Better than: ePM₂.₅, ePM₁₀ or Coarse.
- Replacement for EN 13779 (2012) will be developed
- BS 16798 Part 3 ‘Energy performance of buildings’ will replace EN 13779 using ISO 16890 (PM) and ISO 10121 (gases)
- Draft BB 101 for indoor air quality in schools?
### Swedish Embassy – London Clean IAQ study Particle reduction by air filtration

<table>
<thead>
<tr>
<th>Particles (millions per m³)</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside</td>
<td>361</td>
<td>292</td>
<td>295</td>
<td>228</td>
<td>372</td>
</tr>
<tr>
<td>Inside</td>
<td>167</td>
<td>148</td>
<td>53</td>
<td>19</td>
<td>69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Filter type</th>
<th>City-Flo F7</th>
<th>Hi-Flo F7</th>
<th>Hi-Flo F9</th>
<th>CityCarb F7</th>
<th>CityM</th>
<th>Opakfil F7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle reduction</td>
<td>54%</td>
<td>51%</td>
<td>82%</td>
<td>92%</td>
<td>81%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Note: Readings were taken during a week of high air pollution in London March 2015. During these events HVAC filters were severely challenged and stretched to deliver clean indoor air. 10 million particles per m³ and below is required for clean healthy air. Nitrogen dioxide, the other associated health damaging traffic air pollution gas, was also correspondingly high during this period.
3. ‘In’ – Priorities

- Mitigation of pollution – reduce energy use
- Adaptation – protect occupants
- Improved liability management by building owners
- Ensure air filtration complies with the latest standards e.g. ISO 16890 ePM$_1$, ISO 10121 and BS:EN 13779
- Demand better than just compliance with WHO guidelines for PM and NO$_2$ in planning permissions
- London Plan and Neighbourhood Plans must address indoor air e.g. CO$_2$, NO$_2$, PM$_1$, PM$_{2.5}$ and VOCs
- Respond positively to increasingly public concern
Benefits of air filters

Photo: Lennart Nilsson
We can protect ourselves from 90% of air pollutants for up to 90% of the time

If your office has a mechanical ventilation system or air conditioning (i.e. it is likely to contain the necessary ducting) please ask your facilities manager:

“Does our ventilation system include regularly maintained air filters that comply fully with ISO 10121, ISO 16890 (ePM₁) and BS:EN 13779?”

Ask Camfil for an ‘Air Quality Test’
http://signup.air-cleaner.co.uk/5602156350

For anything else please visit www.camfil.com or call 01706 238 000

Photo of soot particles in air filter
Photo: Lennart Nilsson
5. 61st anniversary of first Clean Air Act

- Build public understanding of air pollution
- Ban diesel, diesel, diesel as we banned coal in 1956
- Restrict polluting activities e.g. ultra low emission zones and/or Emissions Based Road Charging
- Promote positive measures e.g. active travel and car-free centres
- Re-engineer our cities to make us a world leader
The London Matrix – ‘One Atmosphere’

<table>
<thead>
<tr>
<th>London</th>
<th>Air pollution</th>
<th>Climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of world</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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