ENS

Clean air solutions

Dr. Roel Gijsbers

Business Development & Engineering

www.ens-cleanair.com

r.gijsbers@ens-cleanair.com

ENS Clean Air

- Dutch family-owned company, founded in 2009
- Established to reduce exposure to airborne pathogens such as viruses and bacteria
- Knowledge driven, in-house R&D and engineering
- Collaboration with international research institutes and industry partners

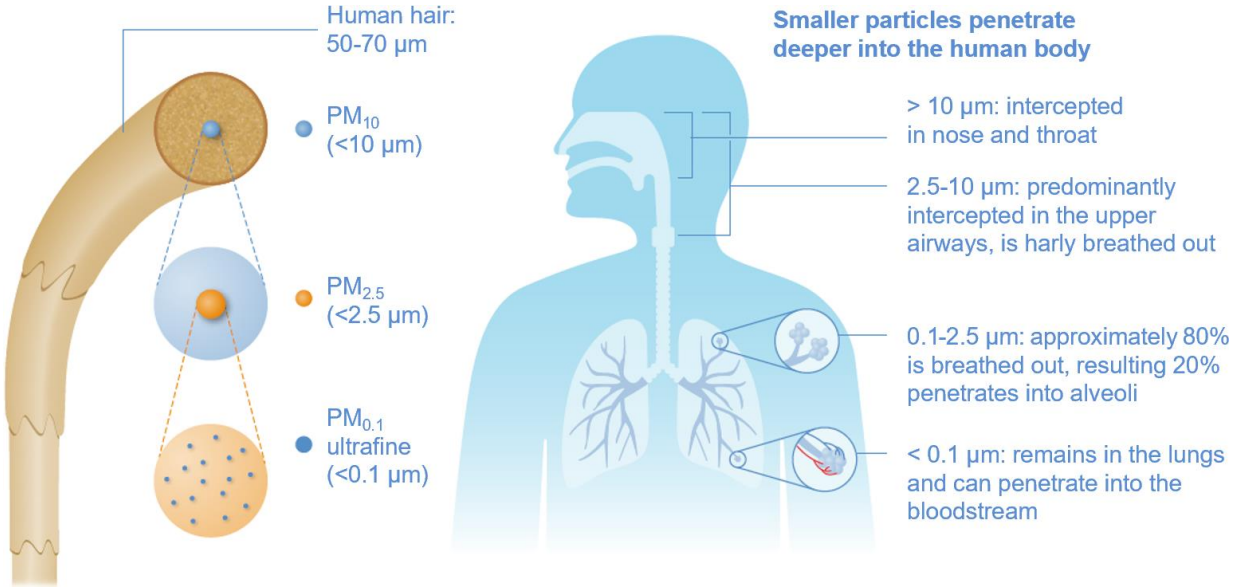
ENS Clean Air

Removal of **particulate matter** and **odor** from ambient air and emission sources

- Urban areas
- Infrastructural works
- Buildings
- Heavy industry
- Agriculture
- Healthcare
- Hospitality

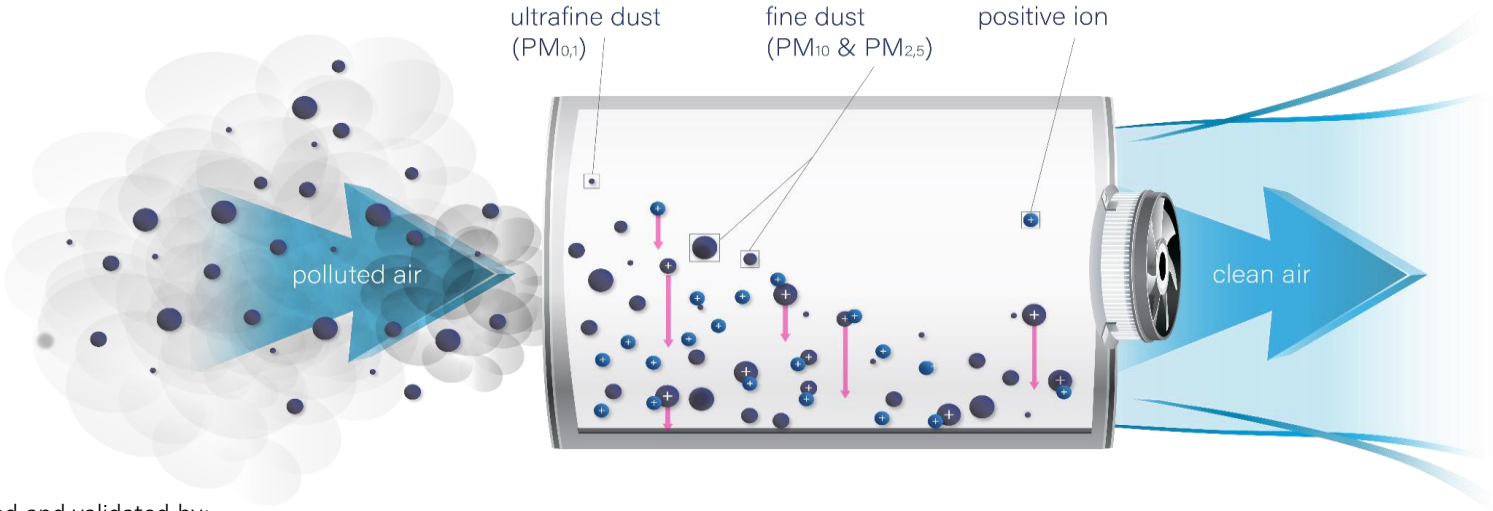
Particulate Matter

Particulate matter (PM) is a mixture of **solid and liquid particles** suspended in air (=aerosols). Fine PM can penetrate deep into the **lungs and bloodstream**. Of all air pollutants, PM by far causes the most **adverse health effects**.



Positive ionization technology

Air is **actively** drawn in, where **Particulate Matter** is positively charged in a strong electric field. As a result, it **agglomerates to coarse dust** and is internally collected.



Measured and validated by:

Positive ionization technology

No filters

Minimal energy consumption

Immune to weather conditions

Non-hazardous

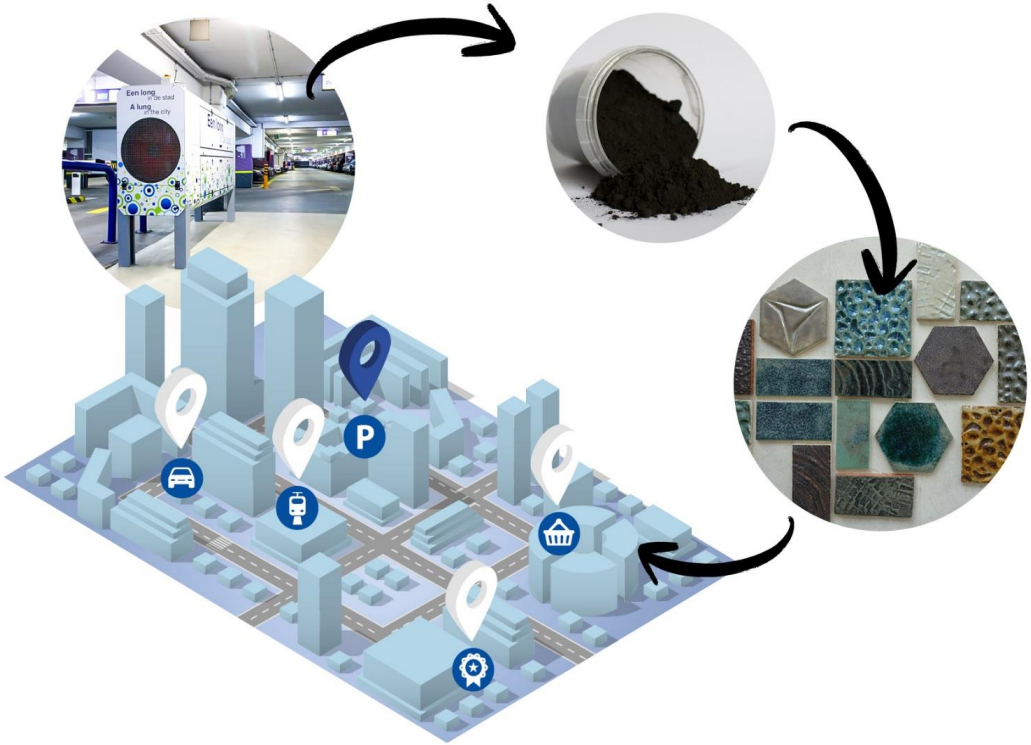
No secondary emissions

x m³

All air volumes

Circulairity

Circular use
of Particulate Matter
residual waste



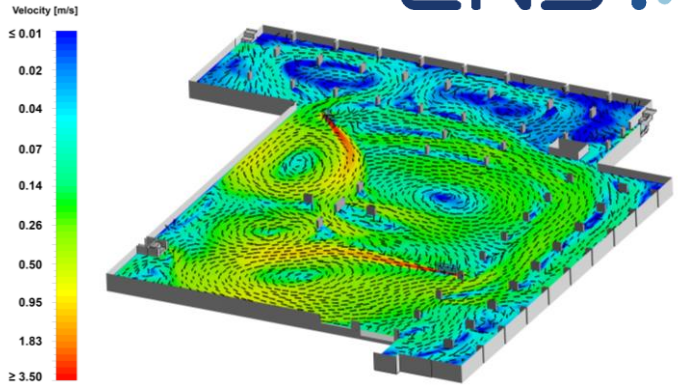
ENS' Engineering methods

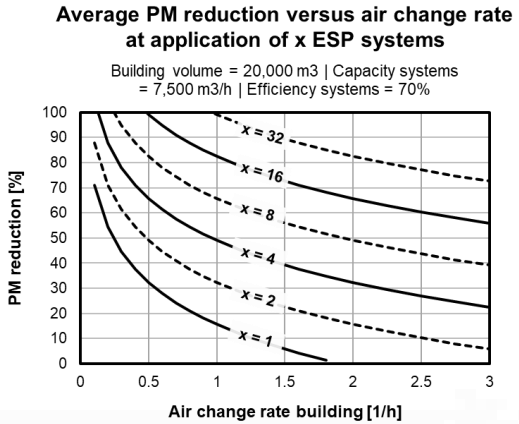
Mitigation Modelling

- Computational Fluid Dynamics (CFD)
  - Air flow and meteorological phenomena
  - Dispersion of polluted/cleaned air.
- Numerical modelling

Measurements (high resolution)

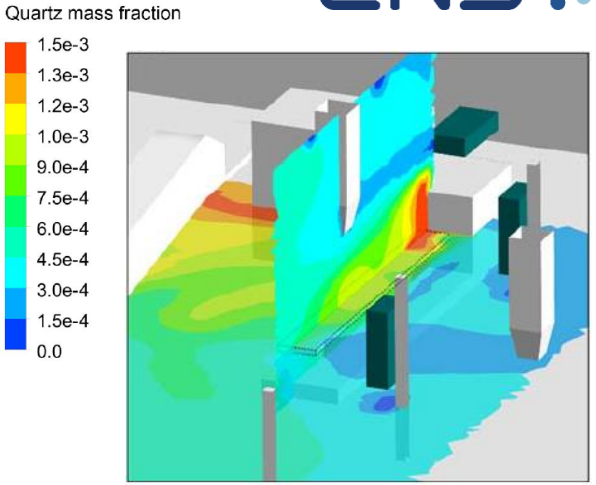
- Treatment efficiency
- Local effect measurements



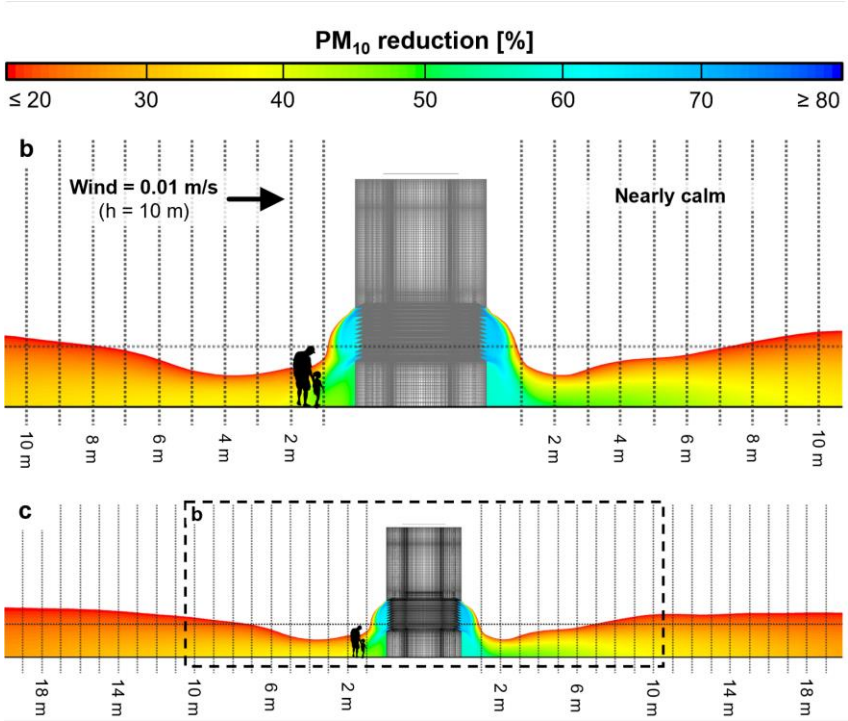


Industry

- Improvement of working environments
- Emission control

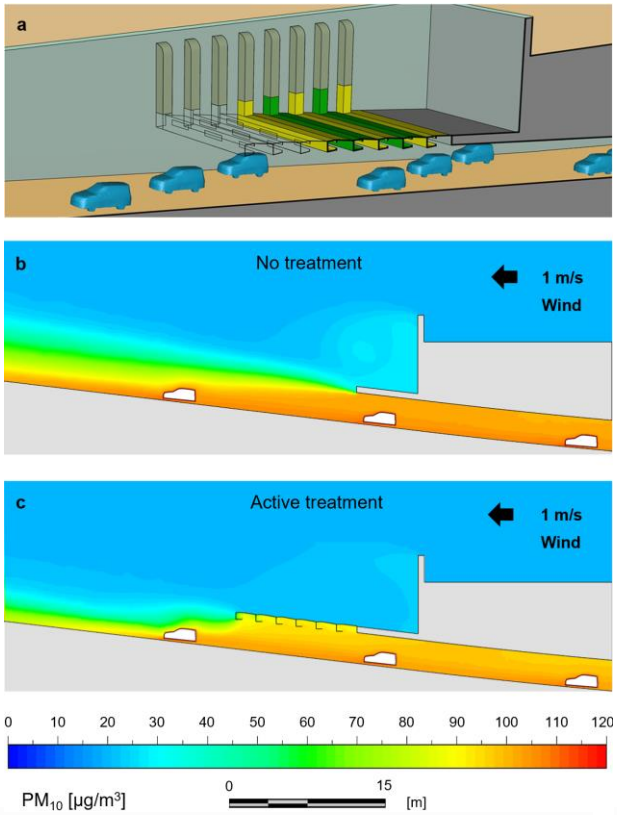


Public spaces



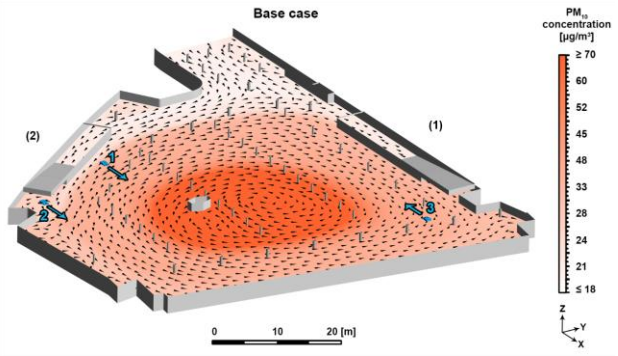
Infrastructure

- Tunnels
- Highway
- Street canyons

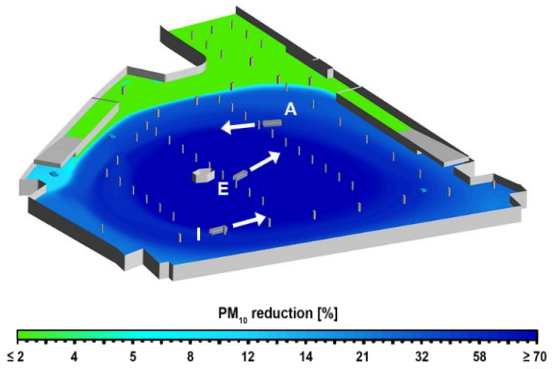


Public transport

Car Parks



Configuration 5 (Aufero A-E-I) - avg. reduction 59%



Vervoort, van Hooff, Blocken (2018). Reduction of particulate matter concentrations by local removal in a semi-enclosed parking garage. Proceedings of Roomvent&Ventilation, pp. 797-802

Lungs of the City

Lungs of the City is an academically proven strategy that uses existing infrastructural facilities **to improve urban air quality** by air quality improvement **at exposure hotspots** such as:

- Squares and parks
- Public buildings
- Parking garages
- Metro stations
- Street furniture
- Bus terminals
- Tunnels

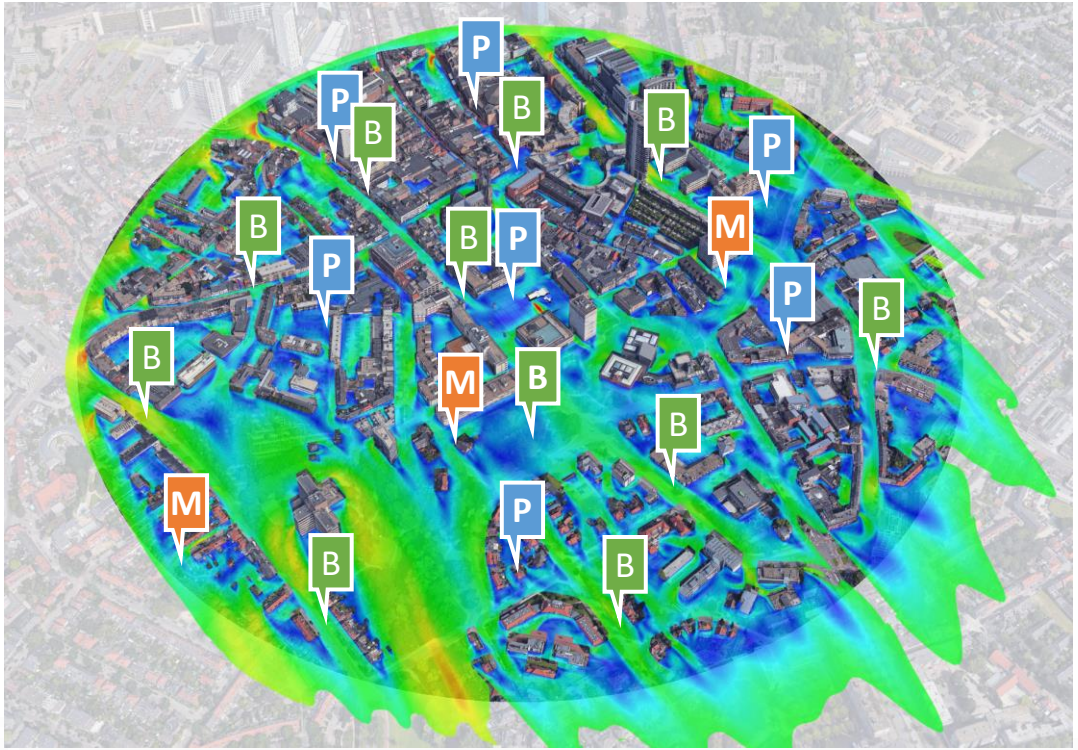
Lungs of the City

Lungs of the City is an academically proven strategy that uses existing infrastructural facilities **to improve urban air quality** by air quality improvement **at exposure hotspots** such as:

- Squares and parks
- Public buildings
- Parking garages
- Metro stations
- Street furniture
- Bus terminals
- Tunnels

Lungs of the City

Illustration of potential urban integration at mobility facilites



M

Metro stations

P

Parking

B

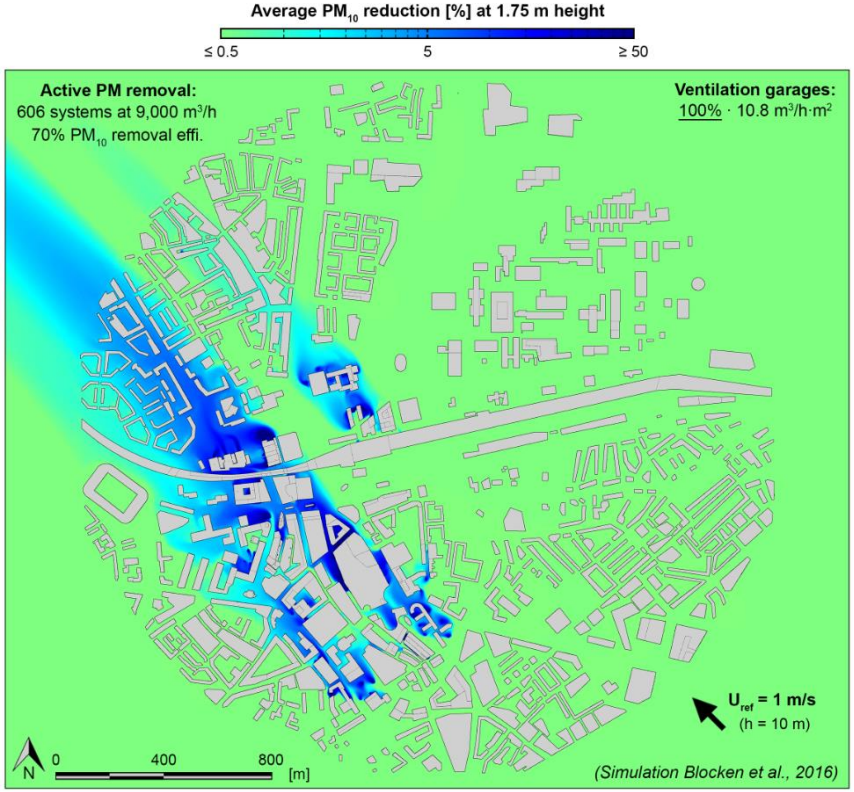
Bus stops

Lungs of the City

Eindhoven (NL) effect study

Cumulative effect of multiple strategically chosen air treatment locations

- Significant reduction of PM concentration in vicinity of hot spot locations.
- Using the underground parking >50% PM reduction can be achieved inside, and 10-50% for the surrounding area above ground. The cleaned air is carried by the wind, so that it also reaches distant areas and shows an air quality improvement up to 1 km away.



Reduction of PM10 concentration at a height of 1.75 m (Blocken et al., 2016).

http://www.sciencedirect.com/science/article/pii/S0167610516304536

Lungs of the City

Eindhoven (NL) effect study

Less exposure at hotspots leads to **reduced health risk** of local population (-25% of disease burden attributed to AQ)

- For the effect area this results in a yearly **socio-economic benefit** of up to 1 M€ per year
- A variety of business cases are explored and confirm that the solution is **cost-effective**

Improvement on Environmental Health Risk indicator for the local population

Lungs of the City

Projects (2014-2021)

These case studies underline the effectiveness of the air purification technology, and furthermore show the efficiency of CFD simulations and onsite measurements (or combination) in assessing the performance of PM mitigation strategies

Area Applications

2015-2020	Smog Free Tower, Rotterdam [NL]; Bejijng, Tjianjin, Dalian [CN]; Krakow [PL]; Anyang [SK]
2015-present	Mobile equipment, Street sweeper Hygion (Ravo)
2016-present	Mobile equipment, Cold mill (Bomag)
2016-2017	A13 Overschie [NL], noise barrier
2016-2020	A15 Noordtunnel [NL] traffic tunnel
2018	Street canyon Amsterdam [NL],
2020	Street canyon Antwerp [BE]
2020-2021	Schoolyard, Poissy [FR], Courbevoie [FR]
2021	Town Square and Shopping Street, Belgrade [SB]
2021-2024	Village d'Athletes – Paris Olympics 2024 [FR]

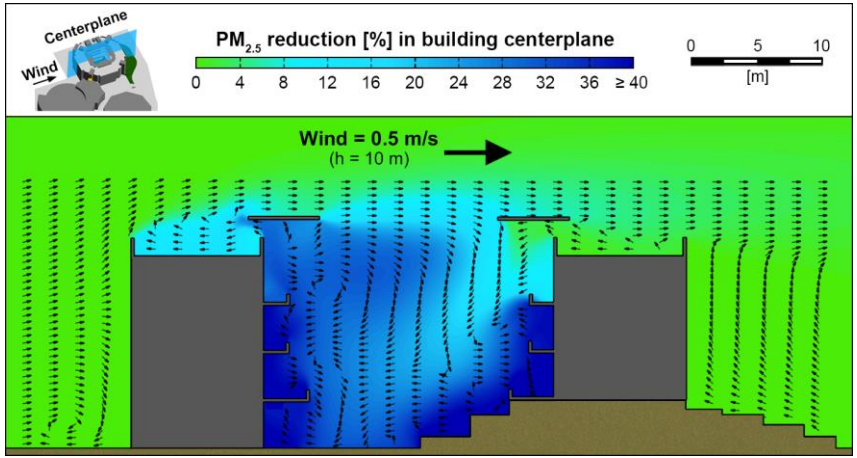
Building applications

2014-2021	20+ Parking garages in the Netherlands, Belgium, France, and Mexico
2018	Courtyard of a School Building, New Delhi [IN]
2019-2020	Avenue Foch Train Station, Paris [FR]
2019-2020	Metro station Alexandre Dumas [FR]
2019-2020	Bus terminal, Seoul [SK]

Lungs of the City

Projects (2014-2021)

Building Applications: Courtyard of a School building, New Delhi, 2018



Vervoort, Blocken, Van Hooff (2019) Reduction of particulate matter concentrations by local removal in a building courtyard: Case study for the Delhi American Embassy School, Science Of The Total Environment, 686 pp. 657-680

Lungs of the City

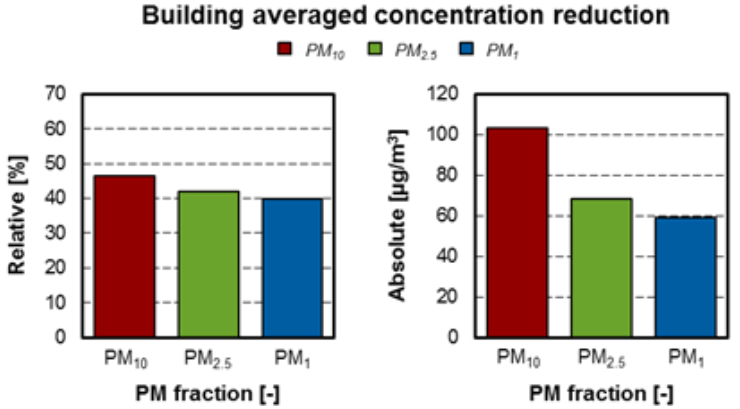
Projects (2014-2021)

Building Applications: Courtyard of a School building, New Delhi, 2018

During the measurement period, the following **PM concentrations** were recorded (10-minute average values):

Maximum background
- PM_{10} 643 µg/m³
- $PM_{2.5}$ 550 µg/m³
- PM_1 513 µg/m³

Overall daily average
- PM_{10} 154 µg/m³ ±68
- $PM_{2.5}$ 118 µg/m³ ±55
- PM_1 107 µg/m³ ±50



	Reference (µg/ m3)	Courtyard (µg/ m3)	Absolute reduction (µg/ m3)
PM10	222.2 ±102.2	119.3 ±49.2	102.9
PM2.5	163.8 ±97.3	95.3 ±48.4	68.5
PM1	147.8 ±92.6	88.9 ±47.5	58.9

Vervoort, Blocken, Van Hooff (2019) Reduction of particulate matter concentrations by local removal in a building courtyard: Case study for the Delhi American Embassy School, Science Of The Total Environment, 686 pp. 657-680

ENS Clean Air Solutions has been awarded with the Solar Impulse Solution Label

YOUR SOLUTION TO AIR POLLUTION

SOLAR IMPULSE
EFFICIENT SOLUTION
NOVEMBER
2019

ENS

Clean air solutions

ENS Clean Air
Grotestraat 41
5431 DH Cuijk (NL)

+31 (0) 486 423 378
info@ens-cleanair.com
www.ens-cleanair.com

Dr. Roel Gijsbers