AN ADVANCED TECHNOLOGY

TO REDUCE AIR PARTICULATE

New Delhi

April 27, 2010

AN ADVANCED TECHNOLOGY TO REDUCE AIR PARTICULATE

New Delhi

April 27, 2010

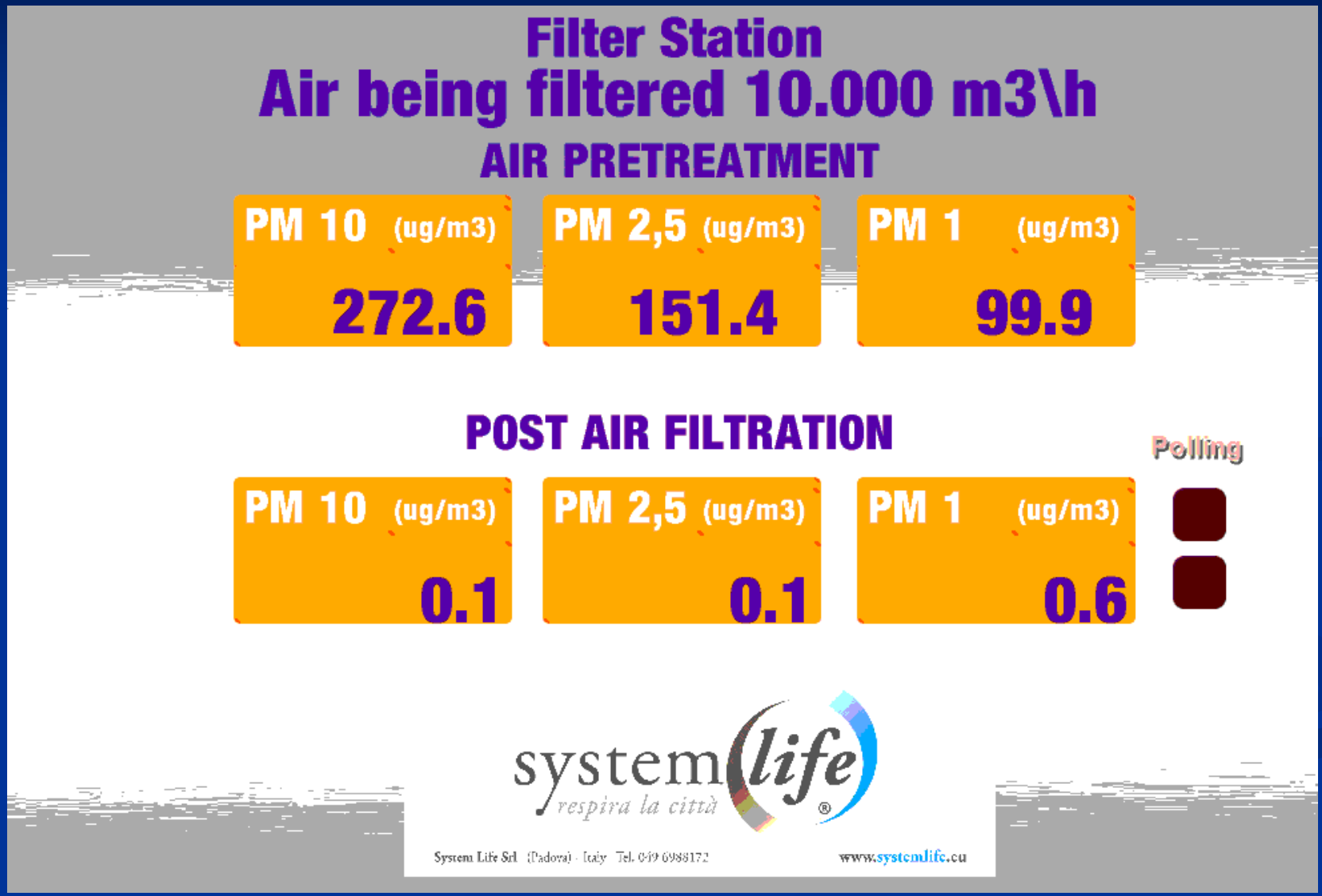
CONNAUGHT PLACE NEW DELHI

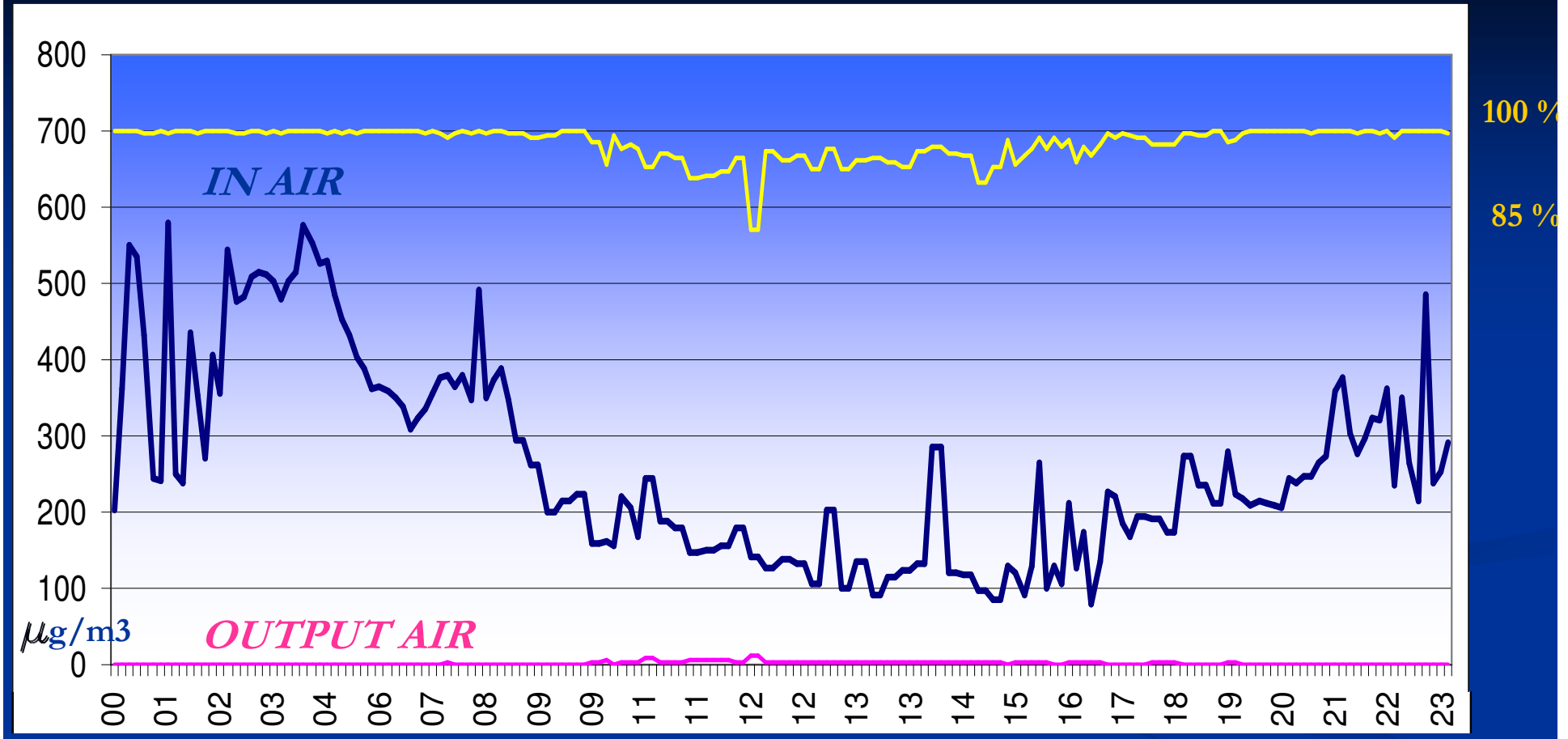
- ***BMA Consulting Services Pvt. Ltd***
  in cooperation with
- ***New Delhi Municipal Council***

On March 06th, 2010 a Systemlife filtering station was installed

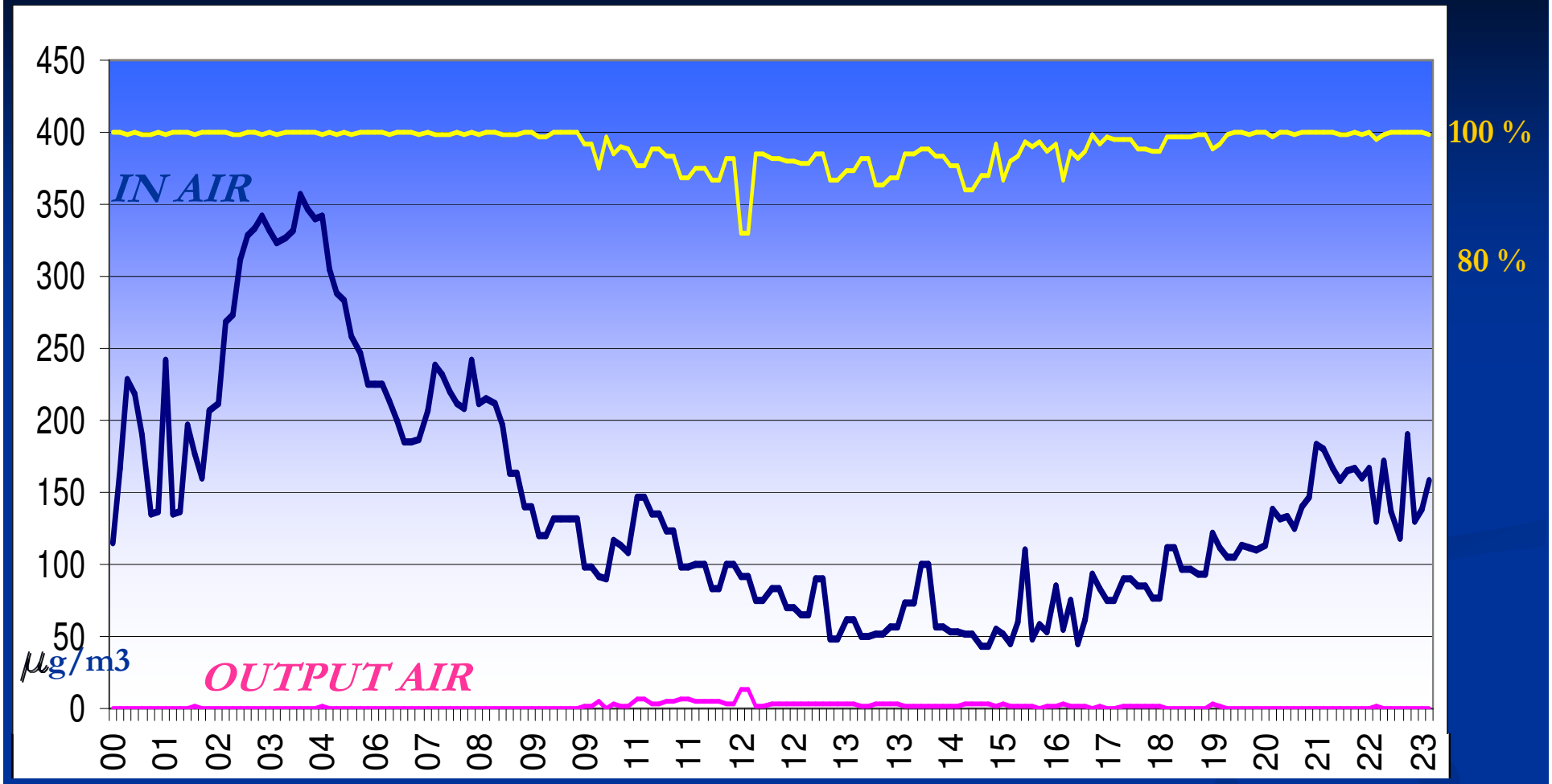
Connaught Place, New Delhi

Instantaneous display of input-output air particulate concentration

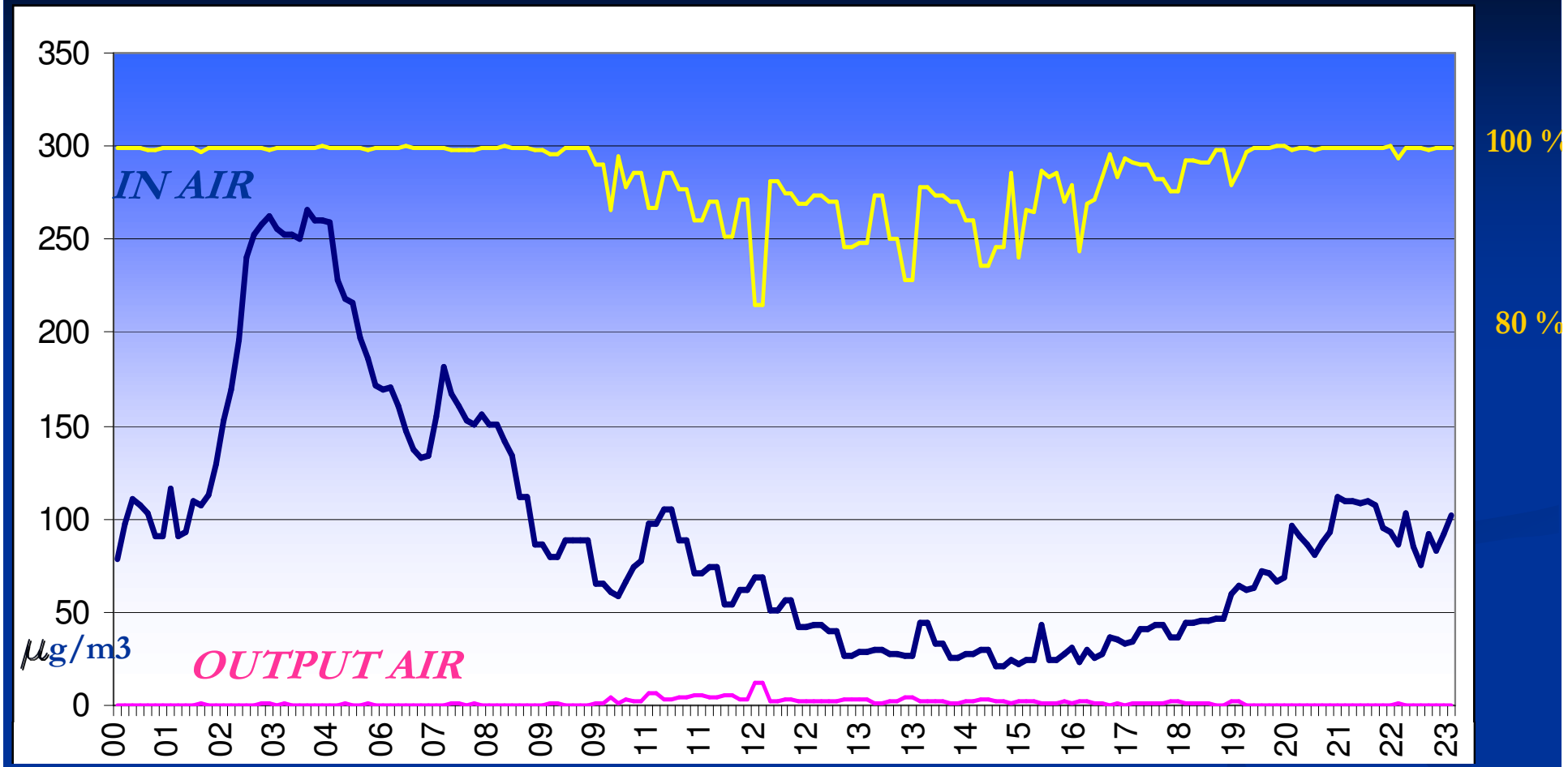




April 08th, 2010 PM 10 Concentration and filtering (%)

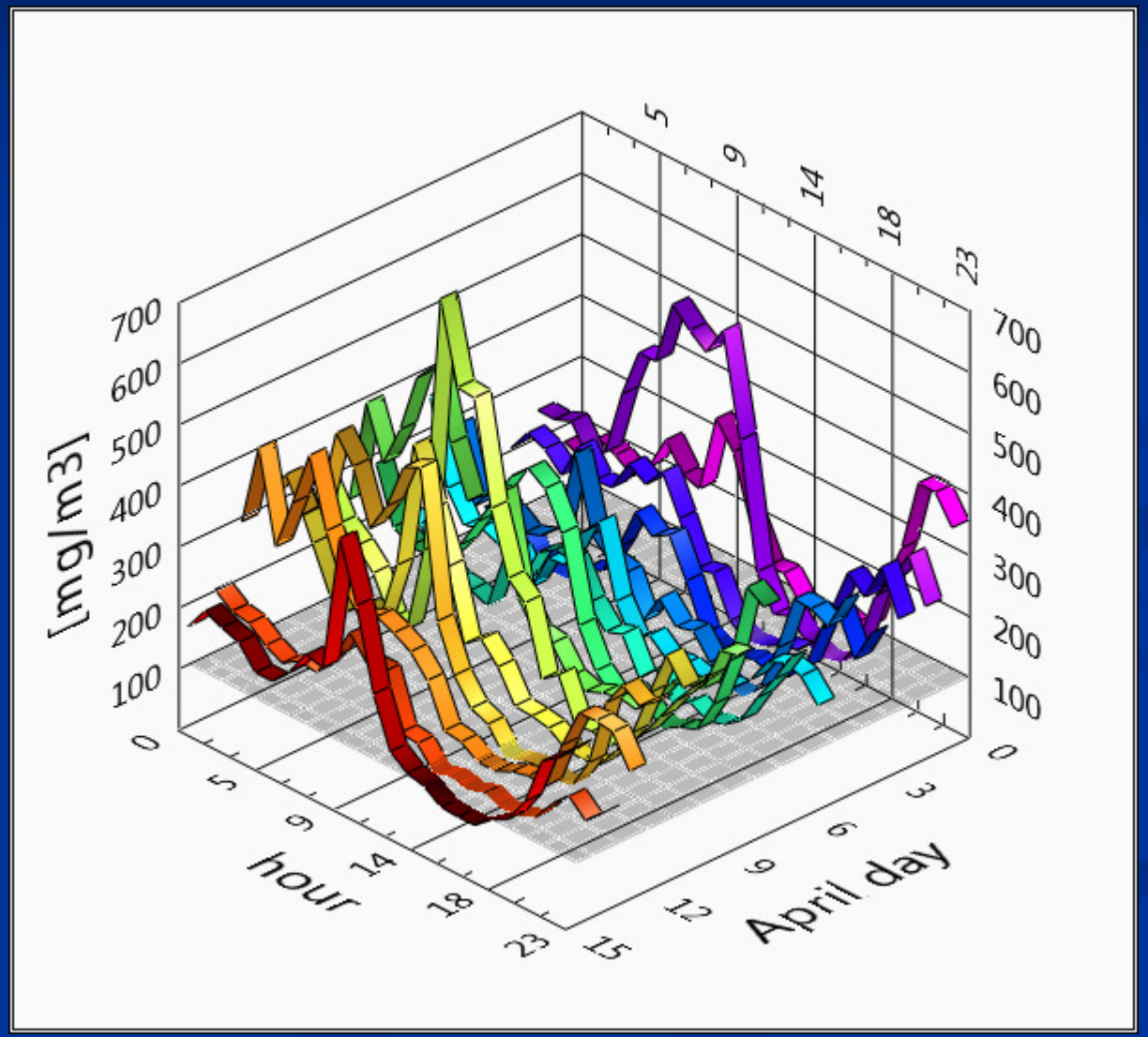


April 08th, 2010 PM 2.5 Concentration and filtering (%)

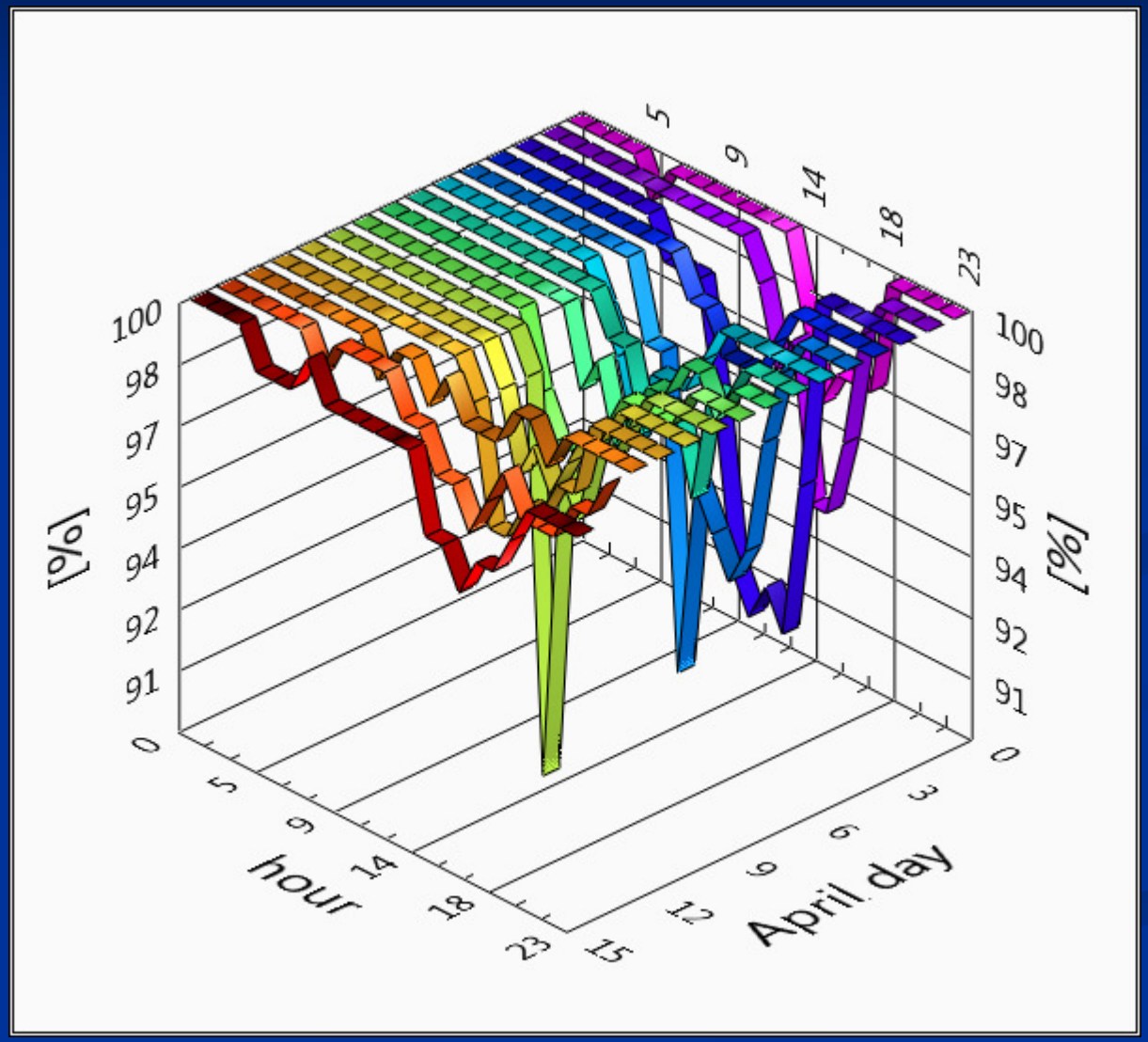


April 08th, 2010 PM 1 Concentration and filtering (%)

Fifteen days ambient air particulate in Connaught Place



Fifteen days filtering efficiency in Connaught Place *systemlife* Station



Main results of the *systemlife* station in Connaught Place test

- 35-day (including start up) test for a total of 860 hours
- Systemlife filtration efficiency 95-99% for all air particulate range (<10, <2.5, <1 and also hight quantity of nanoparticles)
- Output air almost perfectly cleaned up
- Particulate collected in a 35-day time 2,124 g
- More than 20 trillion airborne particles collected in the system

Air particulate
An air pollutant not yet well known

Definition by size

- PM 10: particle diameter < 10 micron
- PM 2.5: particle diameter < 2.5 micron
- PM 1 : particle diameter < 1 micron
- Nanoparticles: diameter < 0. xxx micron

Air particulate
An air pollutant not yet well known

Definition by source:

- Primary: particles emitted by the source
- Secondary: smaller particles derived from the decomposition of primary particles
- "Tertiary" (unofficial): particles already settled on the ground and suspended again in the air by traffic

Air particulate is a very complex system with a tendency to transform itself into smaller and smaller particles

Air particulate
Particle concentration in city air

- Micrograms per cubic meter (PM10, PM2.5, PM1) is the parameter selected by the public authorities for enforcing legislation limits
- Number of particles per cubic meter could be the next parameter for its impact on human health and therefore to define the future air quality standards
- For human health the most important parameters are the number of particles and the inverse of their size

Air particulate
Chemical composition

- Chemical composition of air particulate is very complex and varies very much from one site to another
- Both organic and inorganic compounds are usually identified.
- For the inorganic phase many samples have been analyzed by the Modena University
- For the organic phase, analyses are under way with contracts with several Universities in Italy.
- Very often high concentration of clorine has been found: this clorine most probably is a tracer for dioxin and other harmful compounds

Air particulate
Chemical composition

- Chemical composition of air particulate is very complex and varies very much from one site to another
- Both organic and inorganic compounds are usually identified.
- For the inorganic phase many samples have been analyzed by the Modena University
- For the organic phase, analyses are under way with contracts with several Universities in Italy.
- Very often high concentration of clorine has been found: this clorine most probably is a tracer for dioxin and other harmful compounds

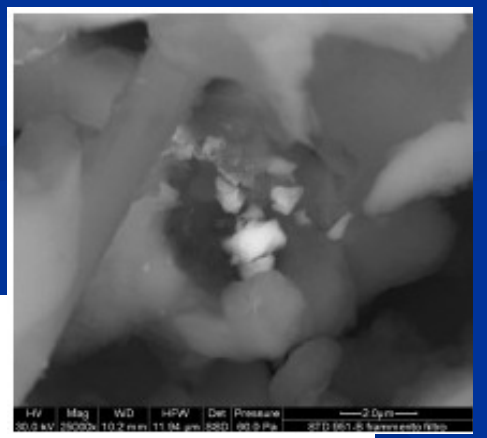
Air particulate
Chemical composition: inorganic phase

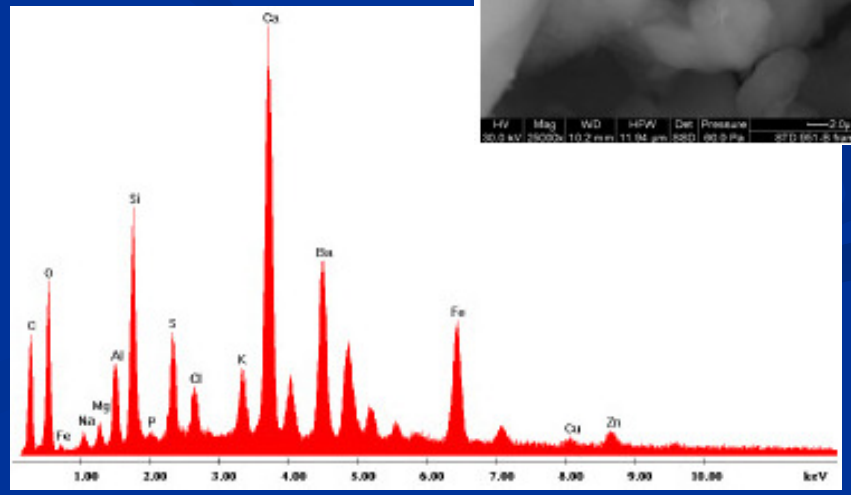
Fine particles 0.3-0.8 micron (Scanning Electron Microscope) collected in Montegrotto Terme (Italy):

C, O, Si, Ca, Fe,

Mg, Al, Cl, Na, S,

P, K, Ti, Zn, Mn, Cu





Air particulate
Technologies and practices to reduce the primary particulate emission at the source

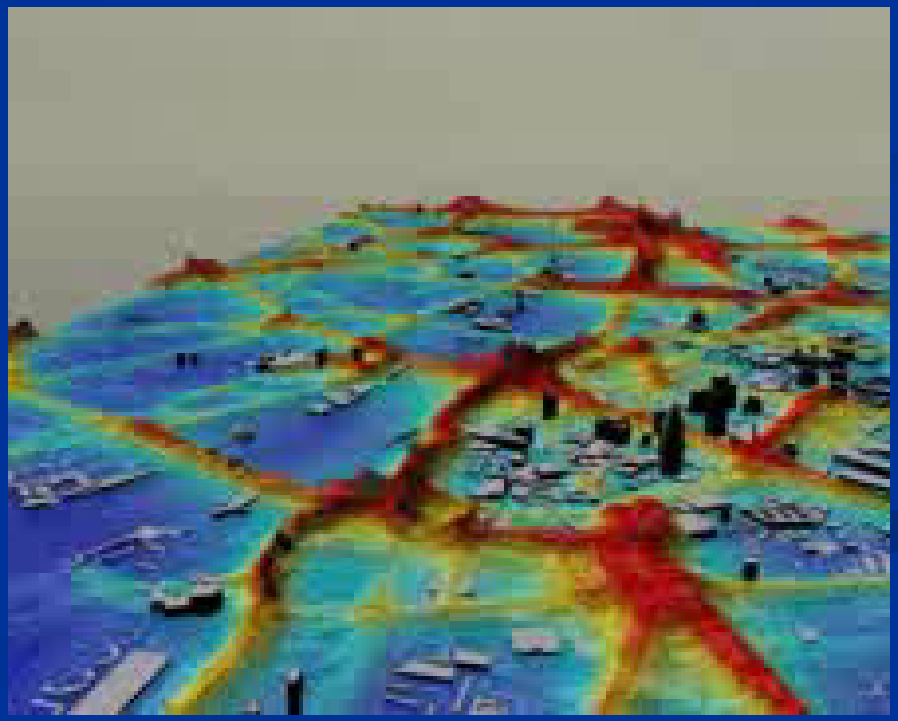
- Lead phase out in gasoline
- Low-sulfur diesel fuel
- No more cracking cycle-oil in diesel formulation
- Particulate filter on diesel exhaust
- NG for district heating
- NG and LPG as clean fuels for city busses and cars
- Exceptionally stop to traffic on Sundays
- Moving heavy industries outside town
- Chimney gas cleaning technologies in industry operation

Air quality in cities today
All these implemented actions not enough

Large, medium and small cities experience particulate out of the limits for many days per year

- Milan
- Rome
- Madrid
- London

London Air Pollution 3D



Possible reasons for such high particulate level

- Many old technology cars still on service
- Particulate diesel filter polluting during regeneration
- Tires and brakes particulate emission
- Oil lubricant in two-stroke engines
- Industry emission management often very poor
- Rain washing-out not much effective on fine particles

Air quality for the future

- Systemlife developed a new concept to reduce air particulate directly in the roads where adults and children breathe

systemlife and LUFT
Two pioneer companies in the technologies for environment

- SYSTEMLIFE SrL

A dedicated company for the research, development, production and commercialization of stationary equipments for the abatement of fine particles in open air and indoor

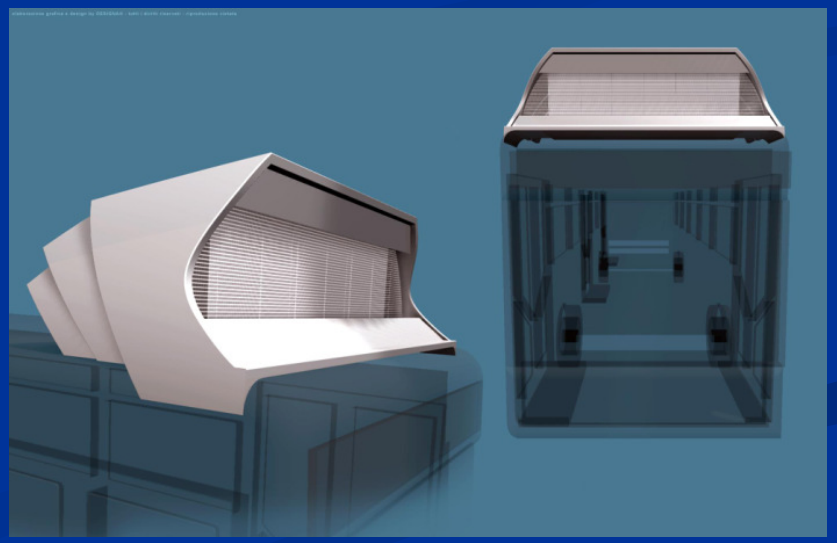
- LUFT Italia SrL

A dedicated company for the production and commercialization of mobile filtration systems fitted on city busses and city trucks

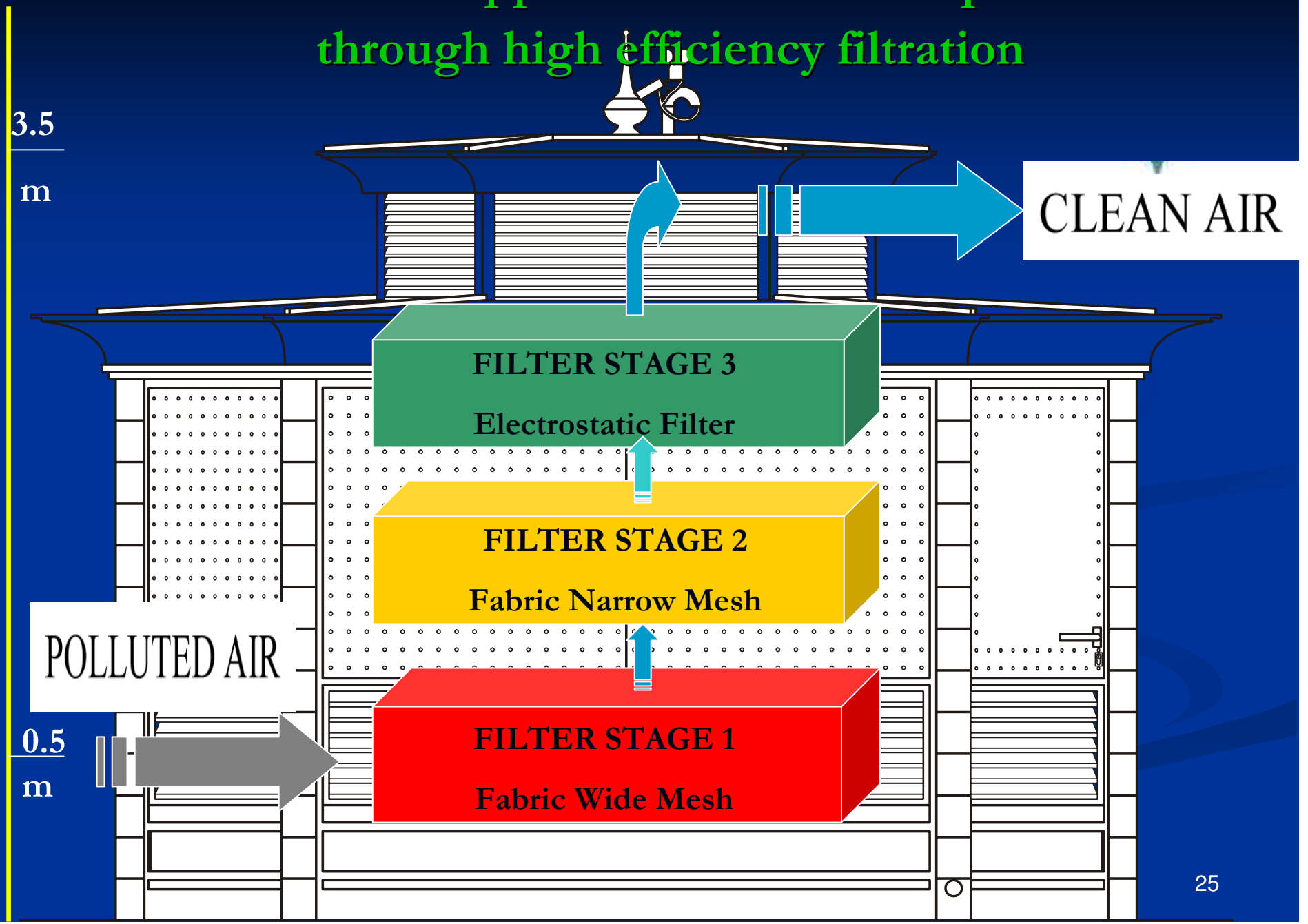
systemlife PRODUCTS

The LUFT SYSTEM

The LUFT system is an air filtering device designed for installation on vehicles (buses, taxis, refuse collection lorries, etc.) in order to improve air quality in urban areas. The heart of the system is based on electrostatic filtering and comprises three high-efficiency filter cells powered by the vehicle itself.



An innovative approach to reduce air particulate through high efficiency filtration



systemlife

Particle concentration measurement

- The filtering station is equipped with a laser spectrometer Grimm (mod 1.108).

  The device allows the detection of the air particles as number of particles or mass, to be converted into concentration data.

systemlife Performance

- Income air flow: 10 thousand cubic meters per hour
- Energy consumption: 5kWh
- Fiber filter more active on coarse particles
- Electro-filter very efficient particularly on sub-micron particles
- Average particulate reduction efficiency almost 95% for all particle size including the submicron particles with some efficiency peaks nearly 100% in the best conditions

systemlife

Electro-filter: the key point for small size

- An advanced electro-filter has been developed for a very high efficiency for fine particles in the range of one nanometer - one micrometer diameter.
- "Secondary Particulate" effectively trapped
- A key point → one "primary" particle of 10 micron can produce a paramount number of smaller particles:
- 64 particles of 2.5 micron diameter
- 1,000 particles of 1 micron diameter
- 1,000,000 of particles of 0.1 diameter

systemlife

The overall efficiency is higher than 95%

- The minimum level of 95% efficiency has been selected as the best compromise between air flow, particle concentration in inlet air, energy consumption.
- Efficiency peaks of nearly 100% have been often experienced

systemlife

Particulate reduction with the distance from the system

- The cleaned air coming from the station dilutes the polluted air with the consequent reduction of the particle concentration.
- Results anticipated by mathematical model
- Experiment done in the town of Feltre (Italy) with synthetic stained particles (tracers) shows as follows:

systemlife Particulate reduction with the distance from the system

systemlife

Particulate reduction with the distance from the system

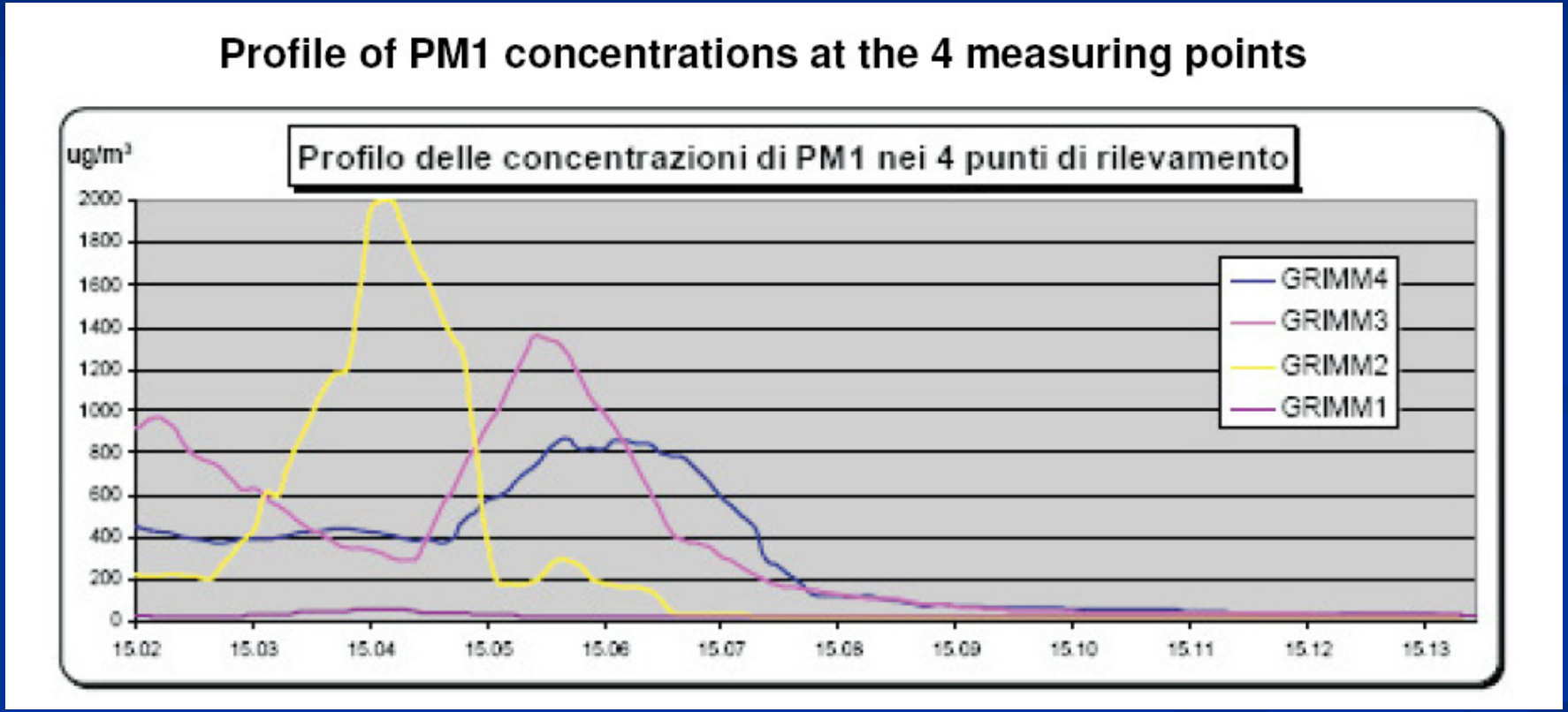


Diagram of PM1 concentrations measured by the four spectrometers positioned behind the filtering station (GRIMM1, purple trace), at 40 m (GRIMM2, yellow trace), at 80 m (GRIMM3, pink trace), and at 120 metres from the filterig station (GRIMM4, blue trace), after the smoke candle was lit.

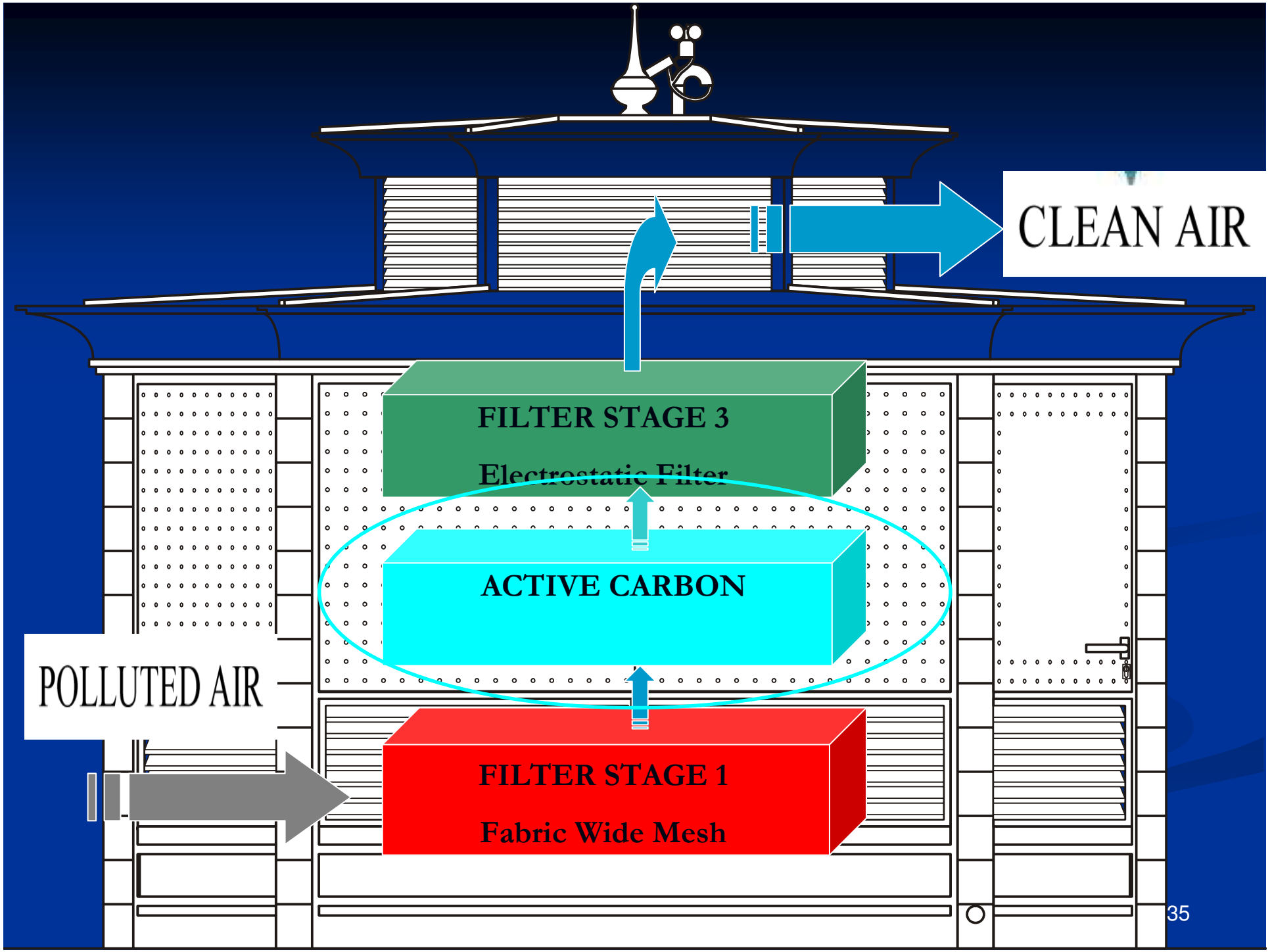
systemlife
Planning number and position of stations

- Systemlife is able to plan an air filtering net for a town or a street or a district, able to meet the desired target in terms of air particulate concentration through a mathematical model developed by ENEA and validated by *systemlife* experiments in several cities.

Systemlife station reduces *also* significantly NOx

- On specific request from BMA, Systemlife station has been implemented to reduce also NOx in filtered air through high active carbon special absorption canisters.

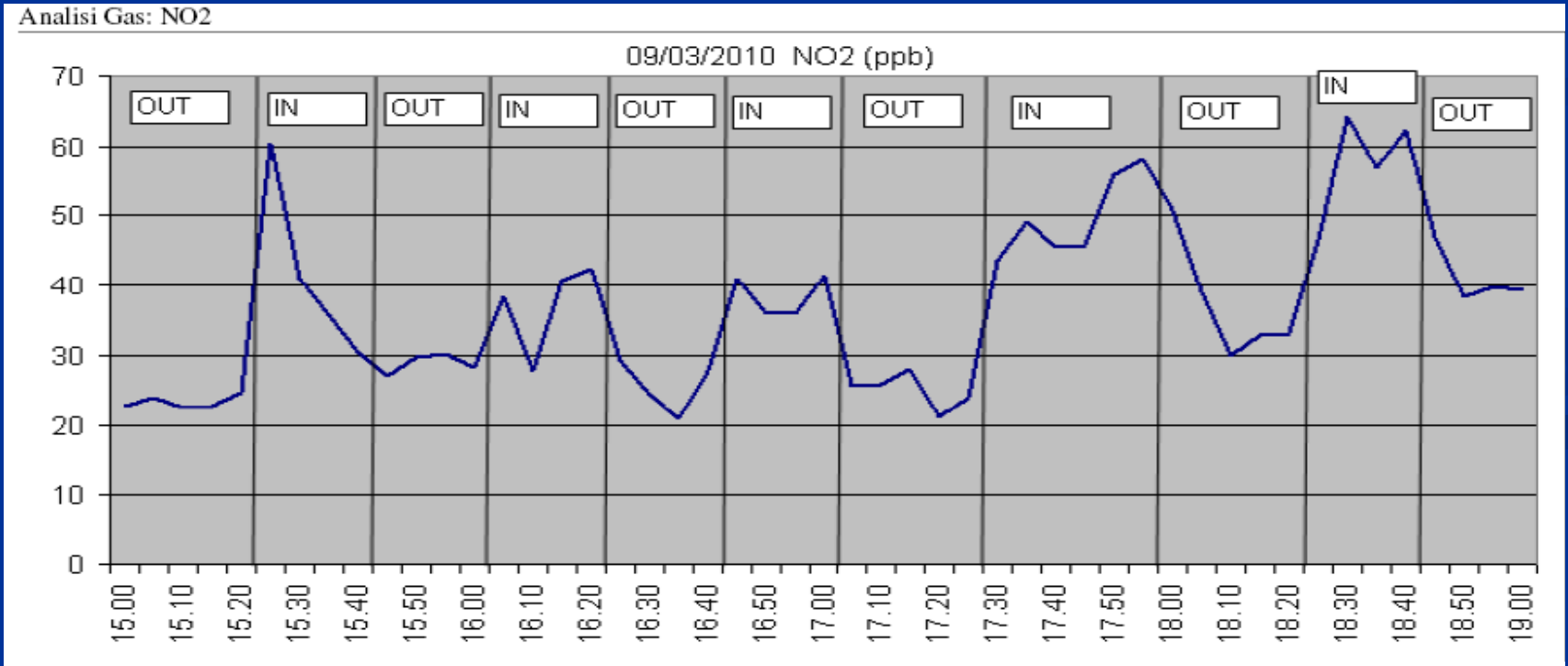
- Such canisters do not affect the particulate filtration efficiency of the system


CLEAN AIR
FILTER STAGE 3
Electrostatic Filter
ACTIVE CARBON
POLLUTED AIR
FILTER STAGE 1
Fabric Wide Mesh

systemlife

NOx reduction results on the Cannought Place test

- NOx in inlet air: 48 ppb (average)
- NOx in output air: 28 ppb (average)
- NOx reduction efficency: 42 %



systemlife

other pollutans reduction results on the Connaught Place test

- Active Carbons particles absorb many gases

  The activity depends on the high surface exposed to absorption per unit volume and it is more marked for the organic gases than for the inorganic ones.

  The box and the carbon quantity are designed for the input air flux of 10,000 m3/h

systemlife
Operations

- The station is automatically controlled and data are exchanged via internet
- Watch dog and alarm operation continuously indicate the possibility of failures
- Systemlife station can operate for many hours and it is stopped in case of strong wind and rain
- Cleaning of the station takes maximum two hours
- Fabrics and electrostatic filters can be changed after eight months
- Active carbons are normally changed every six months

systemlife
Disposal of captured particles

- systemlife can cooperate with a local service company for the particles disposal.
- Thermal decomposition in the high-temperature cement furnace
- Thermal decomposition with special devices for highly toxic material
- Vitrification and disposal of resulted inert material

systemlife

Installations

Some Installation

systemlife
Protection of technology and know how

- patents

system(life) ***s.r.l.*** *– Italian Patent* "for the concept and sequence of filtration processes for outdoor air quality"
N° 3.11.2006 PD A 406

system(life) ***s.r.l.*** *– Patent Cooperation Treaty (PCT) international patent* n° PCT/IT2007/000113 "for the concept and sequence of filtration processes for outdoor air quality"
N° 3.11.2006 PD A 406

Additions to the PCT and filing of patents for other innovative products for outdoor areas, covered car parks, metro and railway stations are currently being made.

systemlife
Benefit

- Apart from the reduction of particulate concentration in city air to meet the air quality standards, Systemlife station ***competes*** with the human beings in capturing and trapping forever the dangerous air-suspended particles.
- A Systemlife station "breathe" is equivalent to 12 thousand people passing nearby during the 24 hour day

systemlife
Cost/benefit analysis

- At present the health dept of the city cannot exactly quantify the care cost reduction for the health benefits attainable by the filtering system, proposed by Systemlife.
- For sure the air particulate represents a high potential risk of many kinds of diseases for adults and children and any reduction of the actual number of such dangerous particles represents a lower number of pathological cases.

CONCLUSIONS

Air particulate can be reduced through the *systemlife* advanced technology

- Systemlife technology collects air particulate forever at adults and children breathing level
- Submicron particles in filtered air are reduced by 95-99%
- An appropriate number of stations can clean up the polluted area at the desired level
- The Systemlife station is reliable, robust, and effective
- Systemlife is responsible for maintenance and dangerous material sustainable disposal through a local service company

info@systemlife.eu