Green Infrastructure
GI4AQ

(Does it all add up?)

Churchman Landscape Architects

Birmingham Institute For Forest Research (BIFOR)

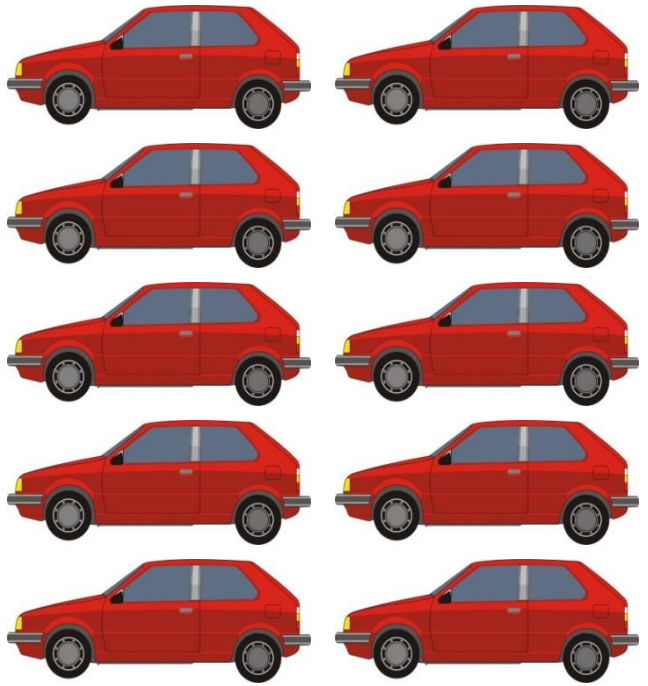

50,000 Preventable
Deaths Per Year in UK
Due to Pollution

Leading cause of mortality worldwide

Worldwide 3 million premature deaths per year

Principal Culprit

1960



2017

Total Nox emissions fell by 37% between 1990 and 2000 and were expected to fall a further 49% between 1999 and 2010. Air Quality Expert Group-Draft Report on Nitrogen Dioxide. UK emissions of NOx fell by 19% between 2010 and 2015 DEFRA: Improving Air Quality in UK May 2017.

Government objective is for every car and van to be zero emission by 2050.


73
LB14 AEC

The Telegraph

HOME | NEWS | SP

Science

Science

Air pollution in London passes levels in Beijing... and wood burners are making problem worse

share 101

By Sarah Knapton, SCIENCE EDITOR
25 JANUARY 2017 • 10:05AM

Air pollution in Londo
figures have shown, with
for exacerbating the probl

On Monday London mayor Sadiq K
alert in London for the first time, a
'filthy air' is now a 'health crisis.'

Readings at 3pm on Monday show
were worse than in notoriously sm
micrograms per cubic metre for pa
Index. Pollution in the Chinese cit
deemed 'unhealthy.'

Although nitrogen dioxide levels i
2014, it is believed to be the first ti
exceeded those in the far east.

Wood burners release significant amounts of par
winter pollution

London breaches air pollution limits for 2018

NEWS / 1 February 2018

reached air pollution limits for the whole year, just 31 days into 2018.

Lambeth on 31 January. Under EU rules, a limit of 200 µg

r.

Environment

Does London have the worst NO2 pollution on Earth?

Academics claimed this week that Oxford Street has the worst nitrogen dioxide pollution in the world. Today the European Court of Justice is hearing evidence in a case against UK's consistent breaches of EU air standards.With your help, Karl Mathiesen investigates how bad things are.

Let us know your thoughts. Post in the comments below, email karl.mathiesen.freelance@theguardian.com or tweet @karlmathiesen

▲ Oxford Street in central London has the world's highest levels of NO2, say researchers from Kings Co
engines in buses and taxis are large producers of the toxic molecules. Photograph: Peter Macdiarmid/G

5.28pm

The Guardian

UK edition

ge Wildlife Energy **Pollution**

Sadiq Khan triggers alert for high air pollution in London

Capital is given emergency warning as polluted air from the continent combines with toxic air at home

EveningStandard.

Three quarters of Britain's worst pollution hotspots in London as new tool reveals air quality in UK postcodes

FRANCESCA GILLETT | Wednesday 10 January 2018 20:23 | 9 comments

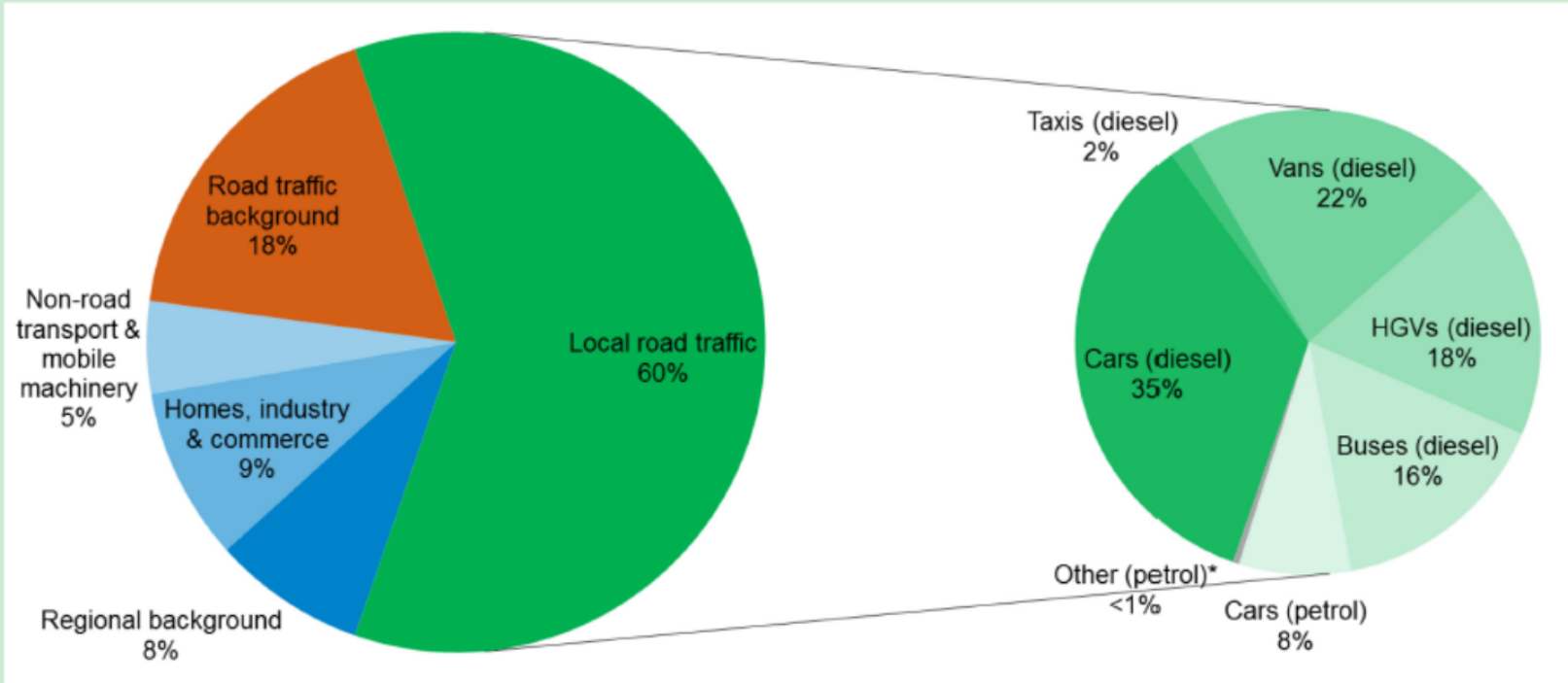
Like Click to follow The Evening Standard

Revealed: every Londoner breathing dangerous levels of toxic air particle

Exclusive: Every area of the capital breaches global standards for PM2.5 pollution particles, with most areas exceeding levels by at least 50%

seen from the Shard. Mayor Sadiq Khan described the new air pollution findings as
Dunham/AP

Figure 3: UK national average NO_x roadside concentration apportioned by source of NO_x emissions, 2015



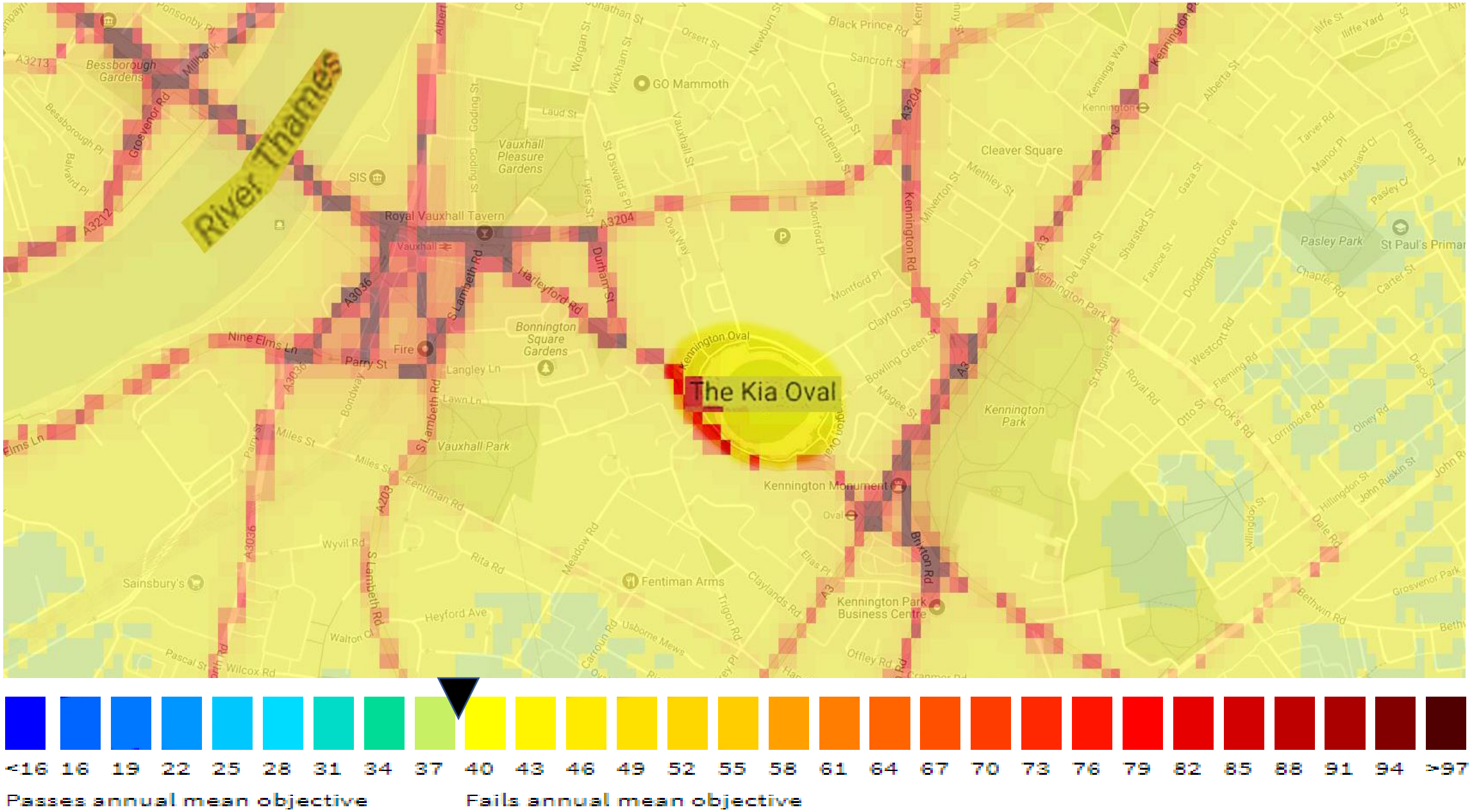
Source: PCM modelling provided by Ricardo Energy & Environment (2017)

Note: 'Local road traffic' in the large pie chart is the estimate of the proportion of local NOx roadside concentrations contributed by traffic on that road and is shown in greater detail in the smaller pie chart. 'Road traffic background' is the estimate of NOx concentrations contributed by traffic on other roads.

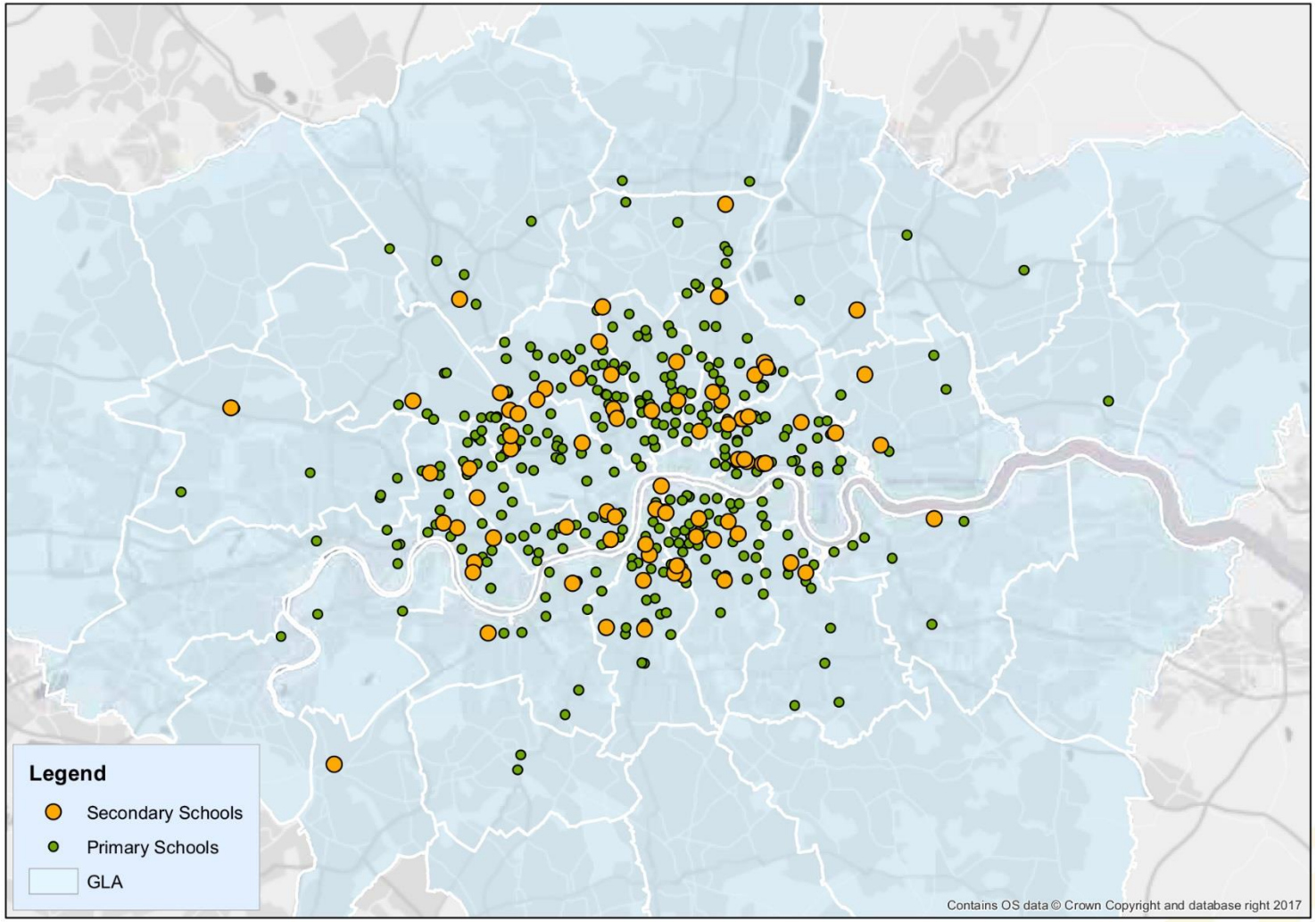
* Other (petrol) is made up of petrol vans and motorcycles.

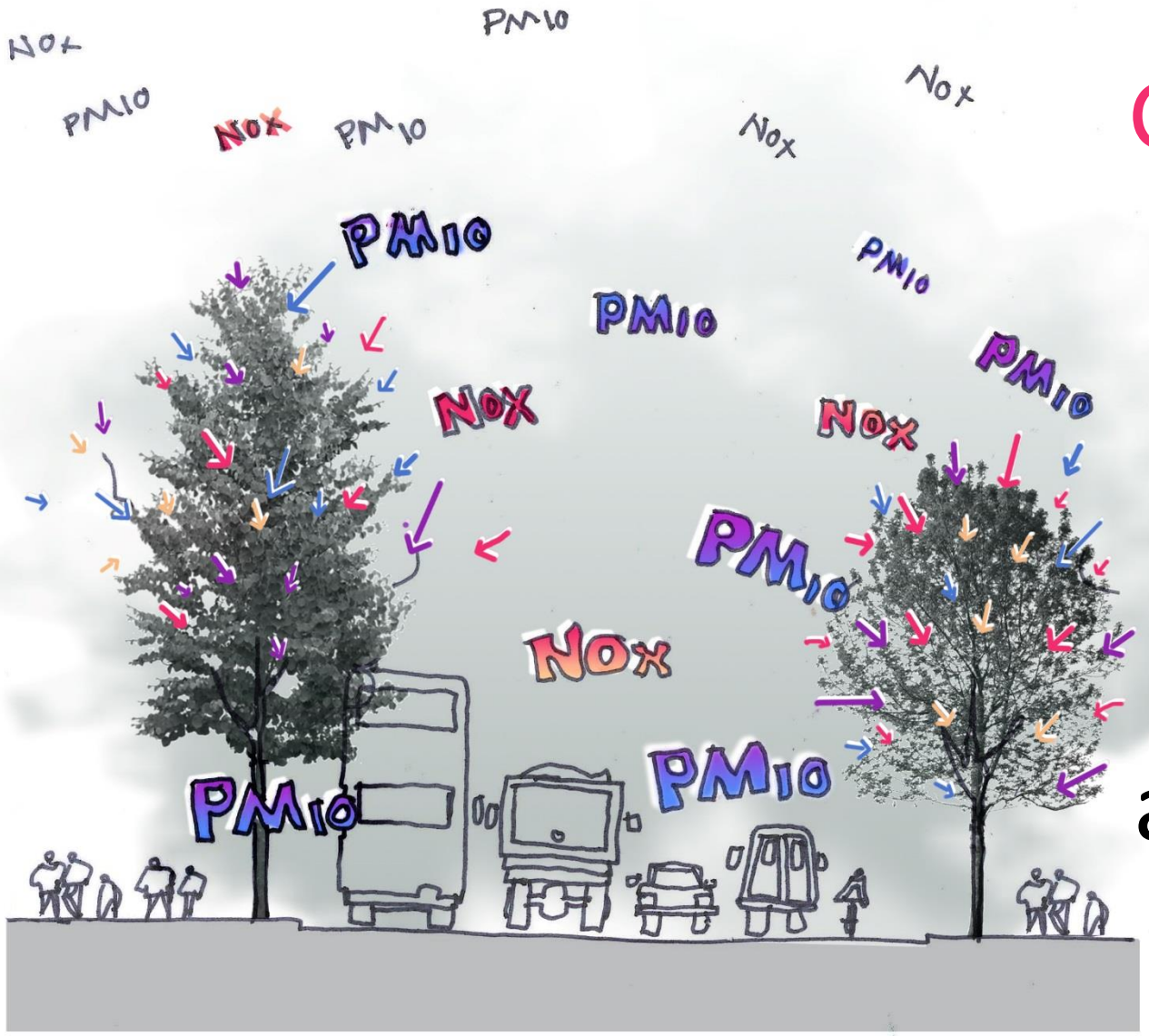
HGVs = Heavy Goods Vehicles.

Pollution events are site and time specific



Schools located in areas where pollution levels exceed recommended thresholds are mostly in Inner London, 86% of the primary schools and 88% of the secondary schools.





Growing claims that GI can help to mitigate pollution

"Trees Can reduce pollution by 40% NOx and 60% Particulates"

Source : Environmental Science and Technology : 2012

More than £1bn saved in health costs in one year thanks to pollution removal by plants

Statisticians have estimated that more than £1 billion was saved on health costs in the UK in 2015 thanks to plants removing pollution from the environment.

The figure is based on an estimated 5,800 fewer respiratory hospital admissions, 1,300 fewer cardiovascular hospital admissions, 27,000 fewer life years lost and 1,900 fewer premature deaths in the UK in 2015 because of the role vegetation plays in removing pollution. In 2015, UK vegetation was estimated to have removed 1,354k tonnes of the particulates PM2.5, SO2, NO2 and O3 from the atmosphere.

The Office of National Statistics (ONS) commissioned the Centre for Ecology and Hydrology, the Economics for the Environment Consultancy and EMRC to conduct a natural capital analysis of the effect of vegetation on pollution.

Healthy Design, Healthy Places

Mayor offers £1 million green grants to improve air quality

30 August 2017

The Mayor of London, Sadiq Khan today visited the Royal Botanic Gardens Kew, in Richmond, as he encouraged community groups to apply for his £1 million Greener City Fund to help deliver more air quality improving trees, plants and green play areas in every neighbourhood.

Trees and plants play an essential part in reducing London's dangerously polluted air, as well as being a vital part of our landscape. The Mayor wants to protect London's Green Belt and help make the capital the world's first National Park City. His £1 million Greener City community fund is part of his wider £9 million funding to help schools, boroughs and local groups improve their local environments.

The end of parklife as we know it? The battle for Britain's green spaces

09 July 2017

Britain's parks are in crisis. With councils such as Bristol cutting spending to zero, and land being lost to developers, what's happening to our public gardens?

We can expect, now that cracks are appearing in the government's commitment to austerity, calls for many deserving causes to be released from their starvation diets. Of these, Britain's parks and green spaces have been among the most viciously cut. They cost little in relation to their benefits. They are also assets for the long term, representing years and decades of investment that will be lost if they are degraded or, as is happening in some cases, sold off or built over. If, as David Cameron says, the point of austerity is to give future generations protection against future hard times, it makes no sense to throw away things of lasting capital value. Once gone, they won't come back.

COST FP1204 GreenInUrbs

GREEN INFRASTRUCTURE

Nature based solutions for sustainable and resilient cities

ORVIETO, ITALY 4-7 April 2017

Specifind

Fill in the form specifying your interests and start searching for arboreal plants from which you can get more benefits.

Login

Search Species

Tree Hight

Height at Maturity — Min — Max — m

Locality

Nation: select

Locality: select

Benefits *

- Pollutant Removal — Overall / Specific
  - Overall Rate: 0 (select)
- Low VOC Emissions: 0 (select)
- Low Allergenicity: 0 (select)
- Carbon Storage: 0 (select)
- Air Temperature Reduction: 0 (select)
- Select All

Show in Report

Report

Estimate Values per Area Unit

Generate Report per: Specie / Genus

Show: All

In the report you will get a list of the most used tree species for urban greenery, arranged according to a score (rank) expressing the degree of compliance with chased requirements.

Climatic and site requirements are measured (if you specify the location), the correspondence to the possible required height and the value of the potential environmental benefits of species, weighted according to the specified scale of importance from 0 to 10 (*) .

In the report there are reported indicative benefit estimates for single adult plant (or m^2), too, if required to display them.

Generate Report Reset

VALUING LONDON'S URBAN FOREST

Results of the London i-Tree Eco Project

London's Urban Forest - Key Statistics				Total
Number of Trees	Inner London	1,587,000		8,421,000
	Outer London	6,834,000		
Tree Cover	Inner London	13%		14%
	Outer London	14%		
Canopy Cover	Inner London	18%		21%
	Outer London	21%		
Most Common Species	Inner London	Birch, Lime, Apple		
	Outer London	Sycamore, Oak, Hawthorn		
Pollution Removal (per annum)	Inner London	561 tonnes	£58 million	£126.1 Million
	Outer London	1680 tonnes	£68.1 million	
Stormwater Alleviation (per annum)	Inner London	705,000m³	**£568,935**	**£2.8 Million**
	Outer London	2,709,000m³	**£2.2 million**	
Carbon Storage (whole value)	Inner London	499,000 tonnes	£30.9 million	£146.9 Million
	Outer London	1,868,000 tonnes	£116 million	
Carbon Sequestration (per annum)	Inner London	15,900 tonnes	£987,000	£4.79 Million
	Outer London	61,300 tonnes	£3.8 million	
Building Energy Savings (per annum)	Inner London	£223,000		£260,600.00
	Outer London	£37,600		
Building Avoided Carbon Emissions (per annum)	Inner London	£23,600		£54,600
	Outer London	£31,000		
Replacement Cost (whole value)	Inner London	£1.35 Billion		£6.12 Billion
	Outer London	£4.77 Billion		
Amenity Value (CAVAT) (whole value)	Inner London	£17.6 Billion		£43.3 Billion
	Outer London	£25.7 Billion		
TOTAL ANNUAL BENEFITS	Inner London	£59.54 Million		£132.7 Million
	Outer London	£73.16 Million		

i-Tree

Problems in accurately defining level of mitigation offered

- Too many variables
- Every condition is different
- Conditions are dynamic
- Cannot set up a control

Orientation, elevation, urban pattern, density of buildings, relationship to open space, relationship to natural corridors, rivers etc, relationship to natural topographic features, aspect, Spatial parameters (height to width), Wind direction, wind speed, turbulence, adjacent activities, down wind activities, shading, growth rate of trees, maturity, height and state of existing vegetation, in ground conditions, fertility of soils.

How as designers might we reduce effects of pollution?

- How does pollution enter the atmosphere ?
- What happens once pollutants are in the atmosphere ?
- How are pollutants absorbed by plants ?
- Can pedestrians be removed from source?
- Are there good and bad practices which mitigate/ exacerbate pollution effects?

Principal Pollutants NOx and PM10s

Resulting From vehicle emissions in London

NOx

=

50%

PM10s

=

80%

STRATOSPHERE

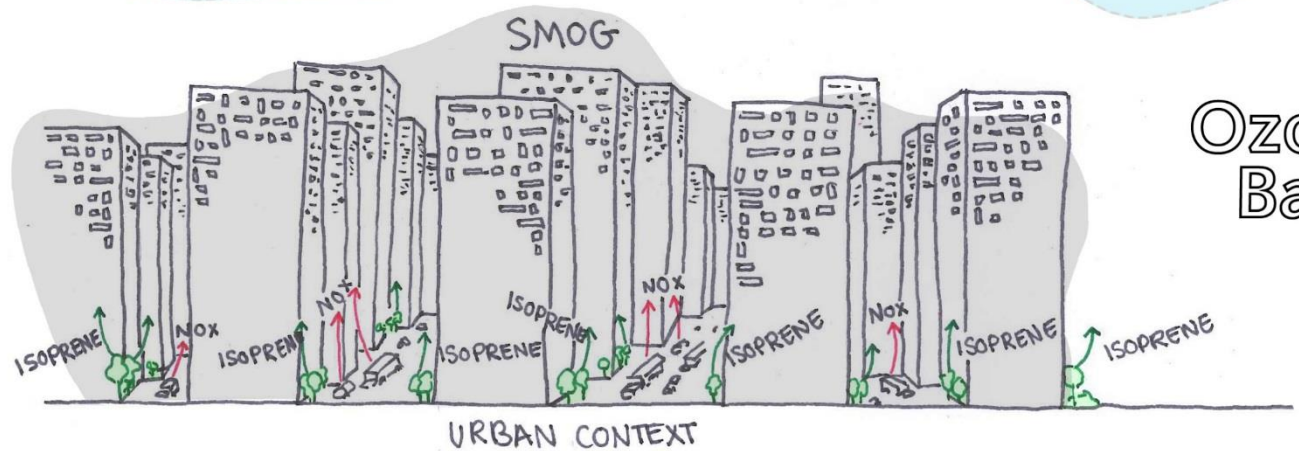
TROPOSPHERE

Ozone
Good

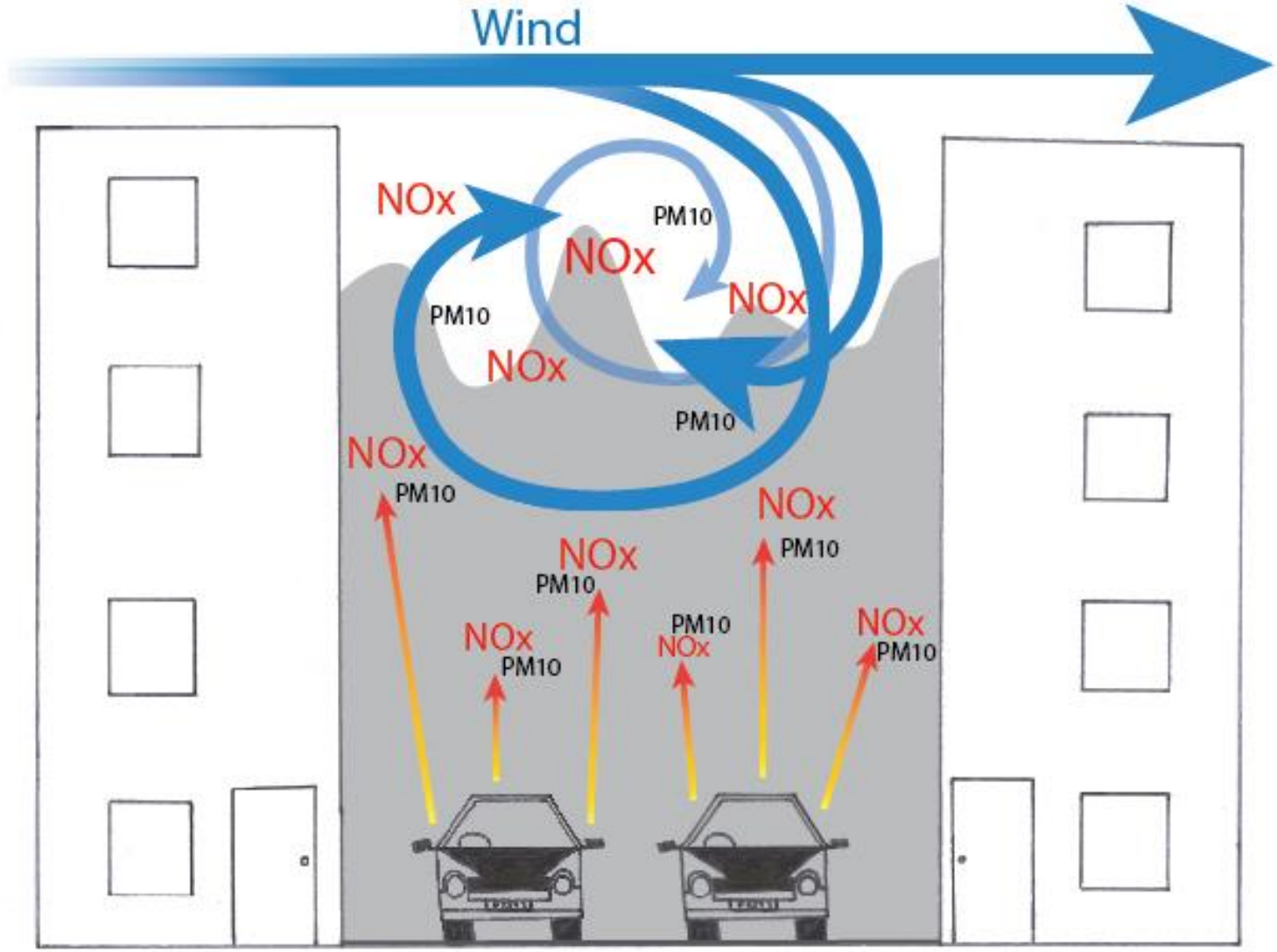
OZONE

OZONE

NOX + Sunlight = OZONE



Ozone
Bad


Wind
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PM10
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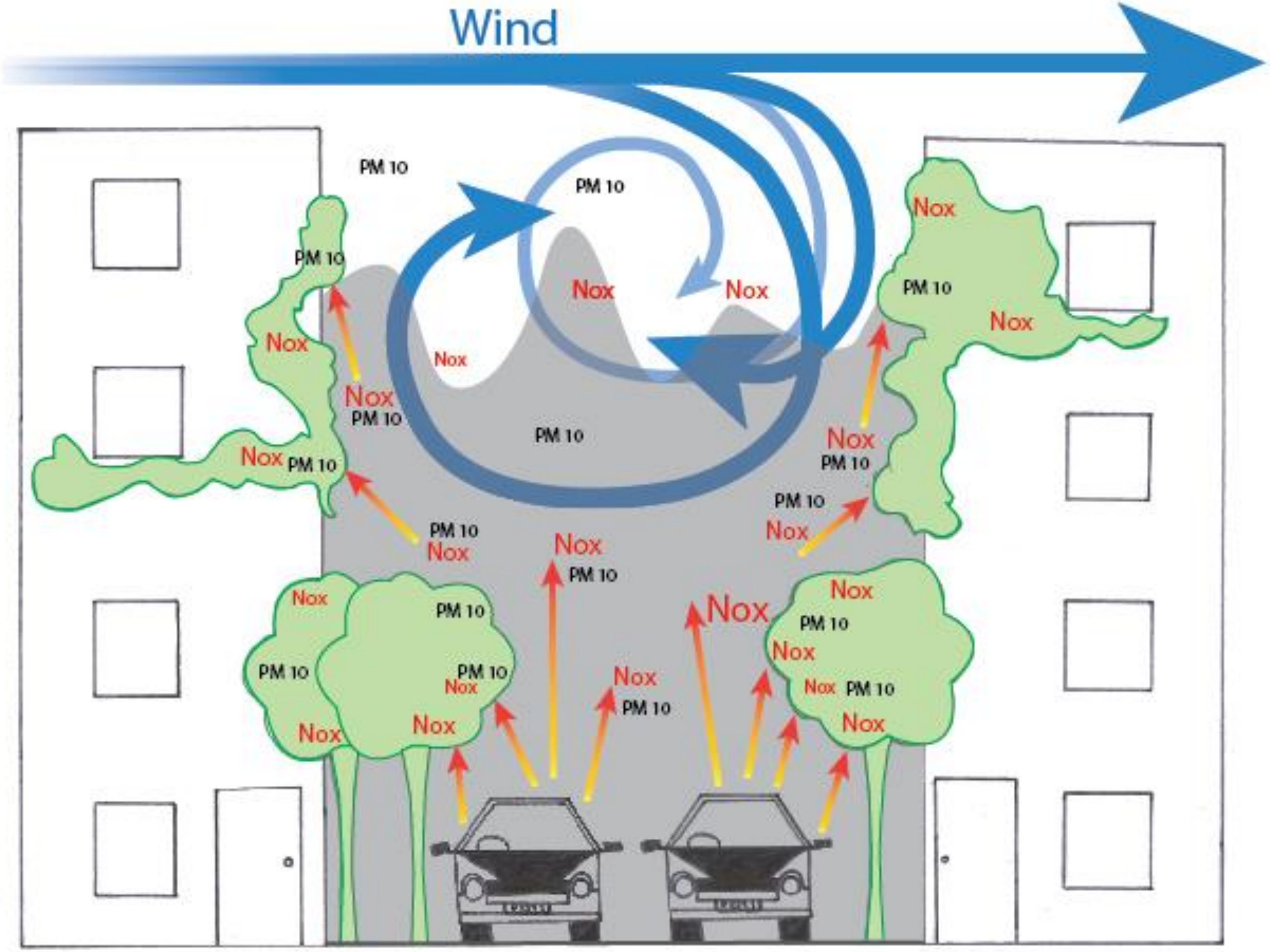

Wind
PM 10
PM 10
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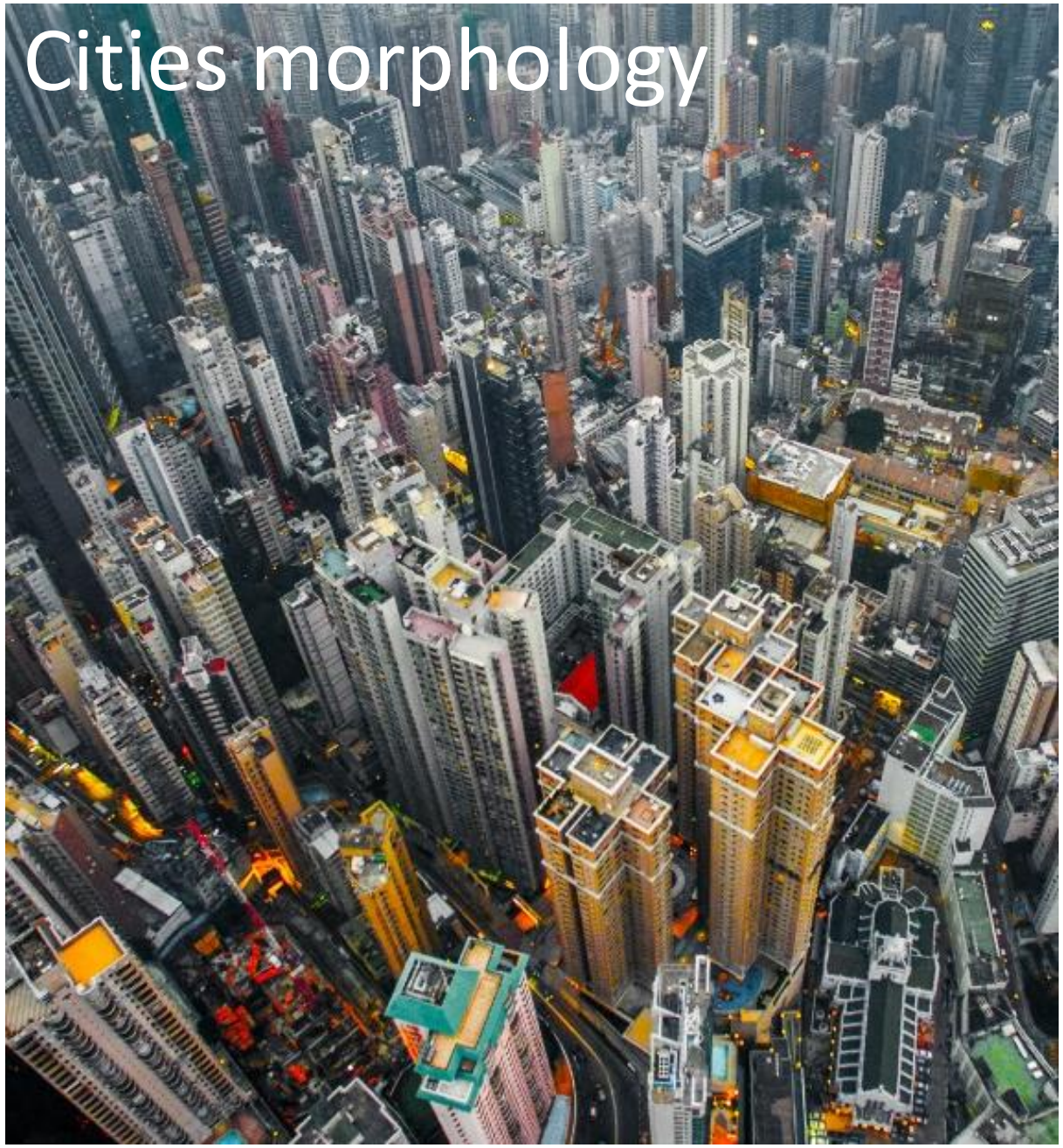
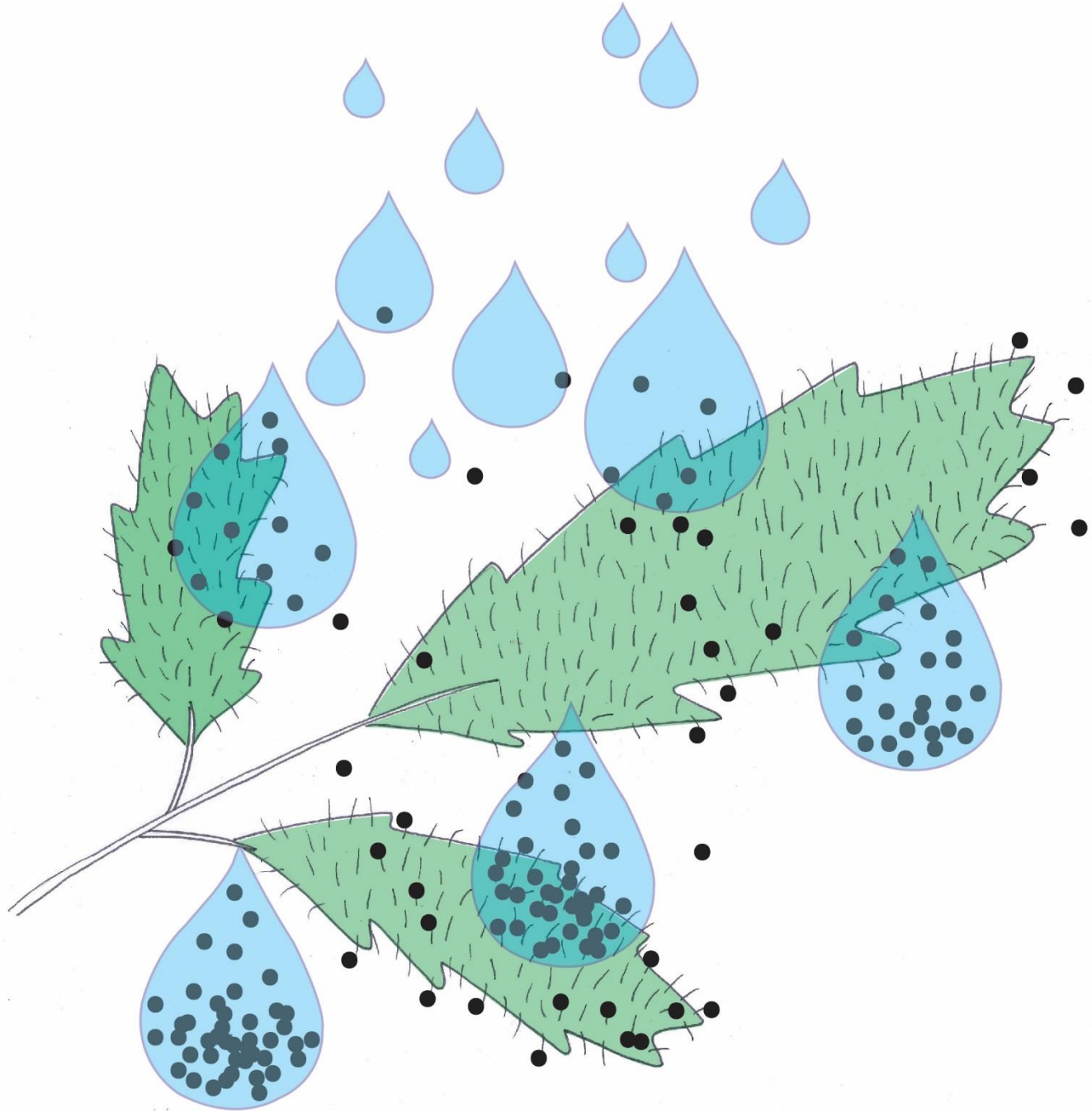
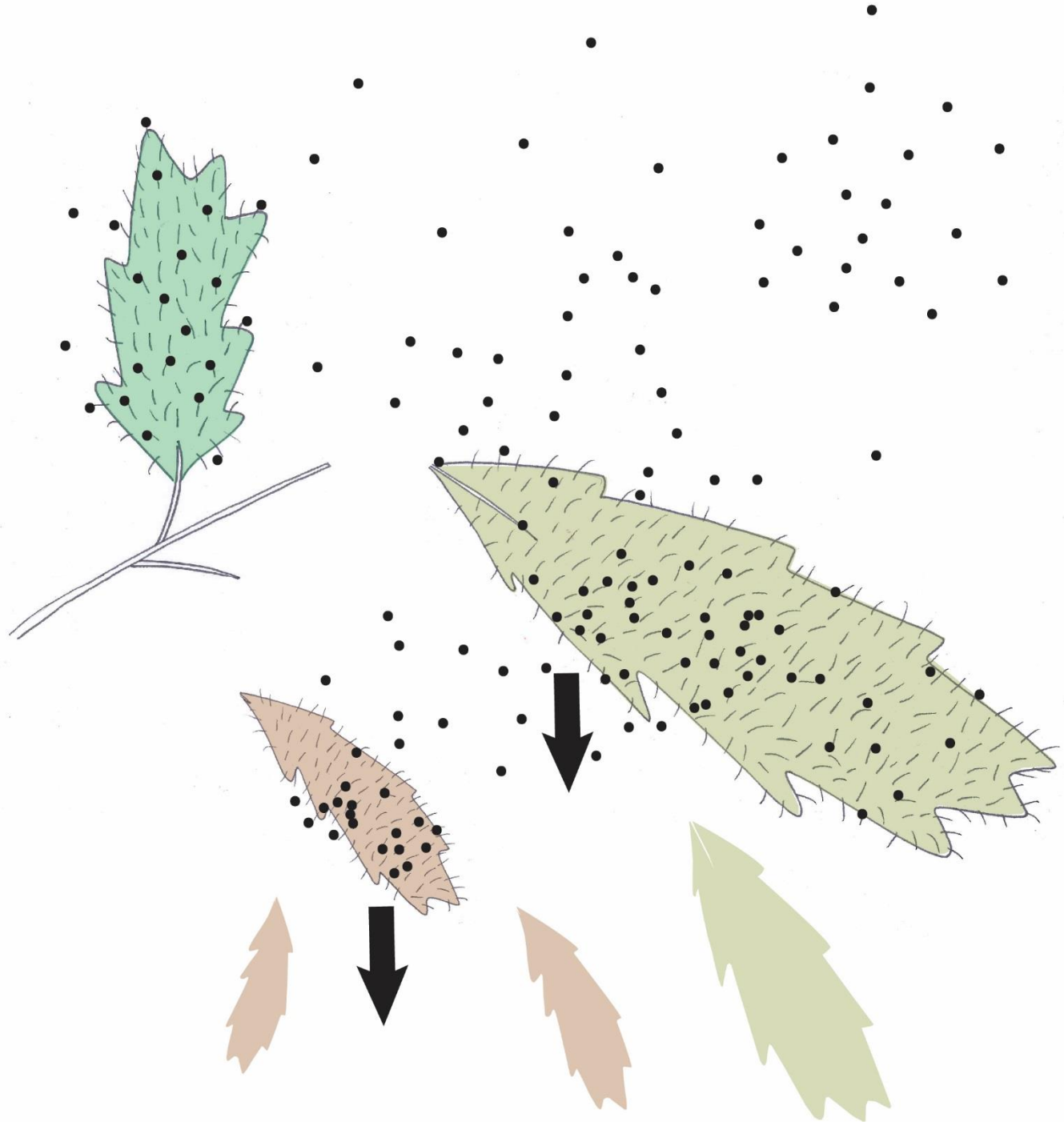
Cities morphology

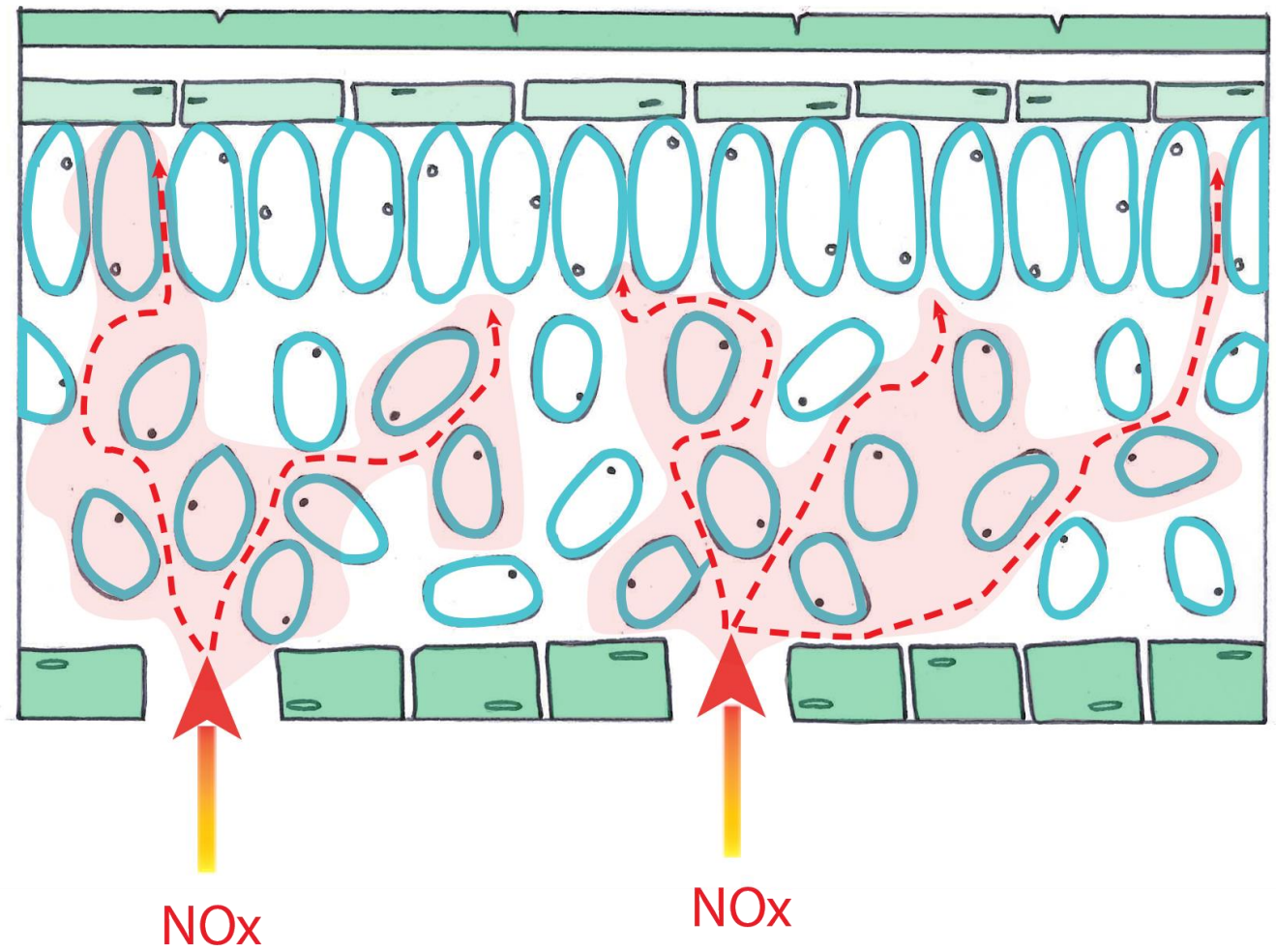


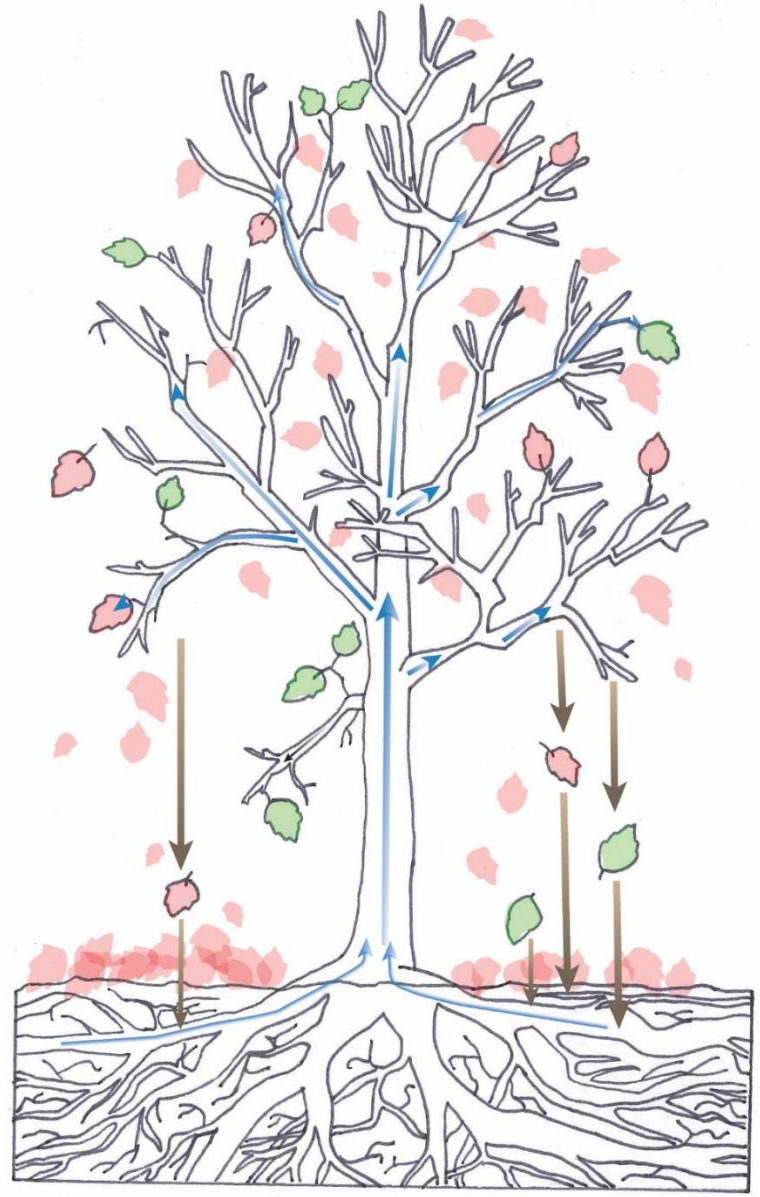
Hong-Kong

London





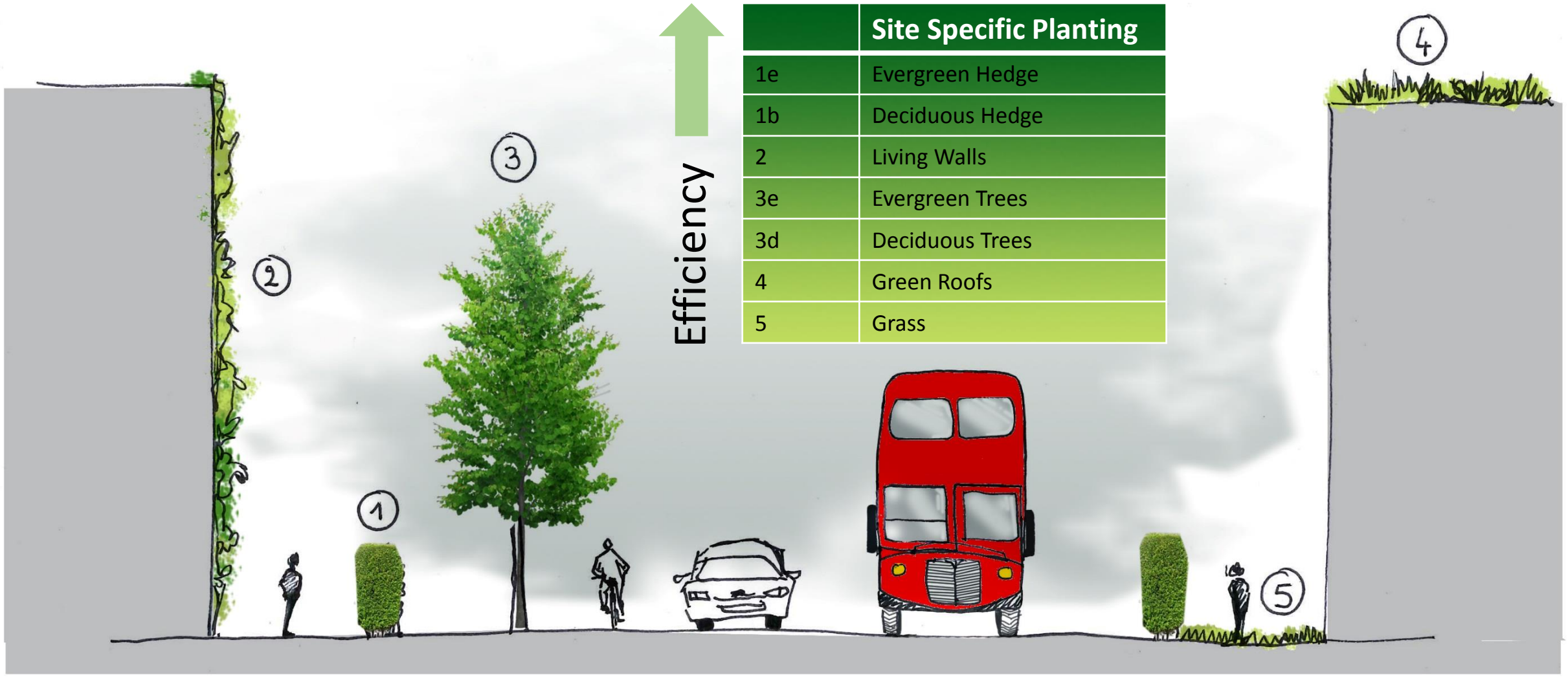

NOx
NOx



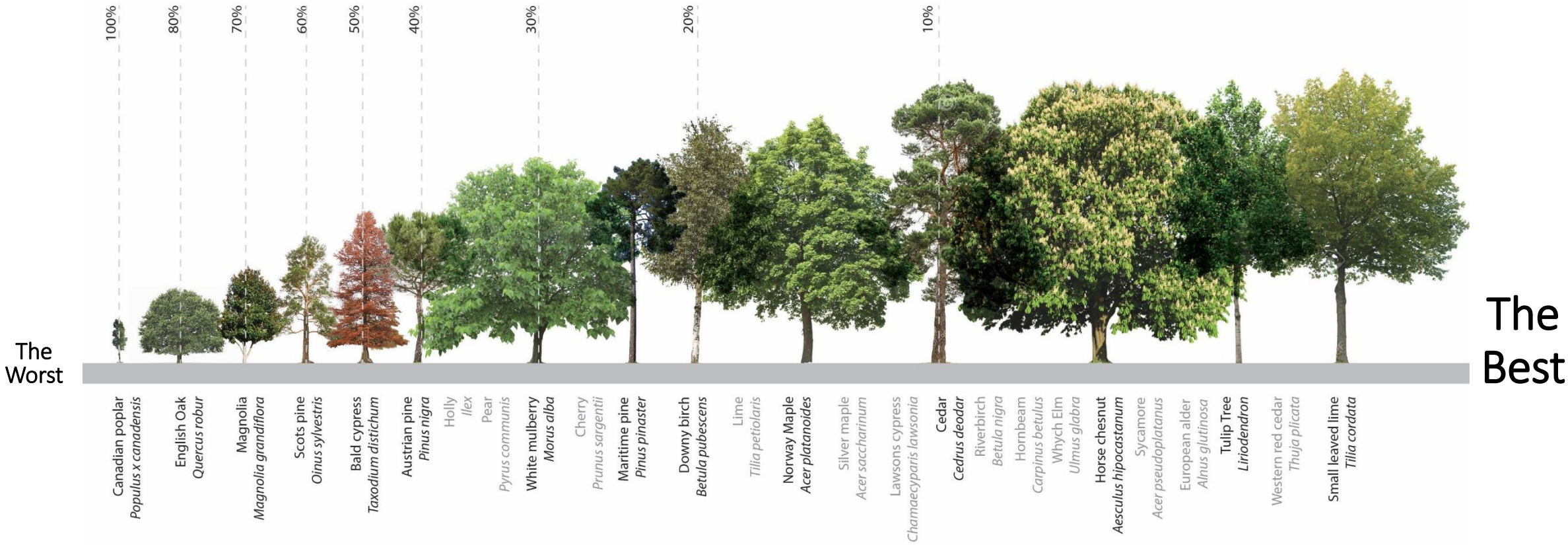
Where are plants likely to be most effective in reducing levels of pollution?

- Where concentration is highest
- Where air mixing is greatest
- Where residence time of pollution is longest
- Where there is greatest separation between source and receptor
- At locations of greatest sensitivity e.g schools, hospitals

Effectiveness of Planting in absorption of pollutants

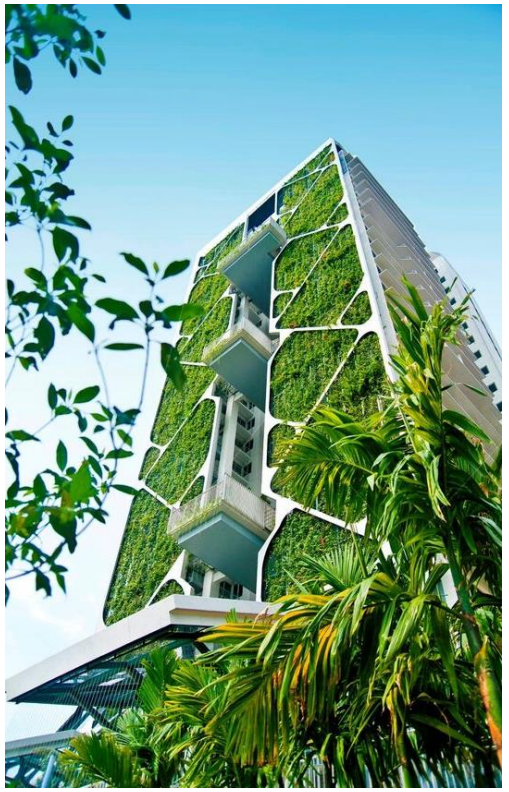


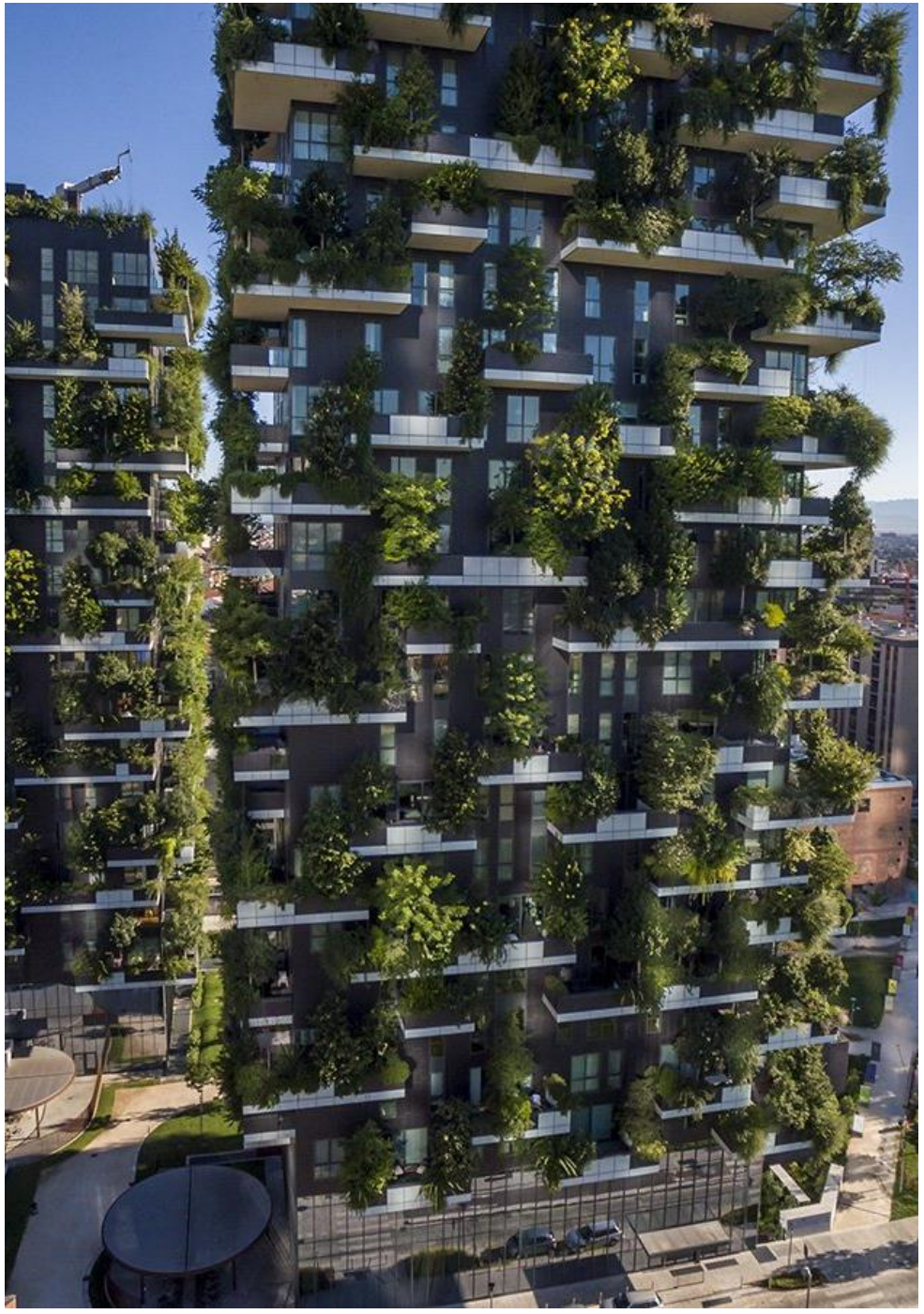
	Site Specific Planting
1e	Evergreen Hedge
1b	Deciduous Hedge
2	Living Walls
3e	Evergreen Trees
3d	Deciduous Trees
4	Green Roofs
5	Grass

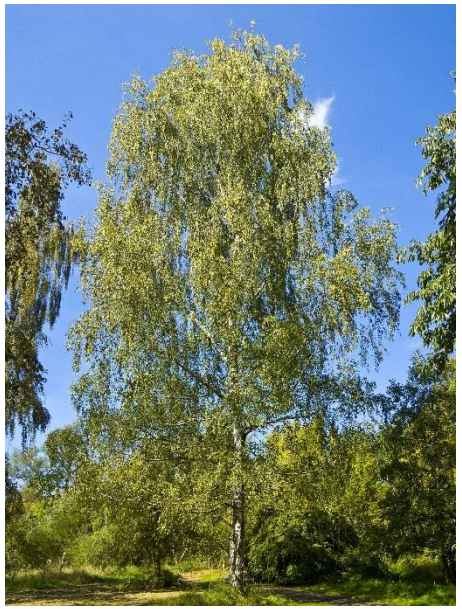


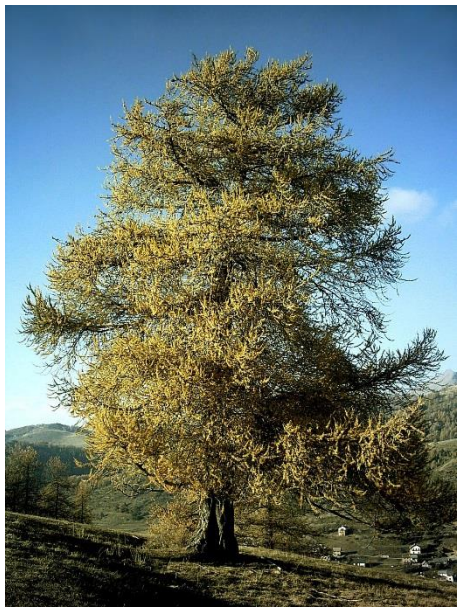
Are there good and bad trees to plant for improving air quality?


581 Transit

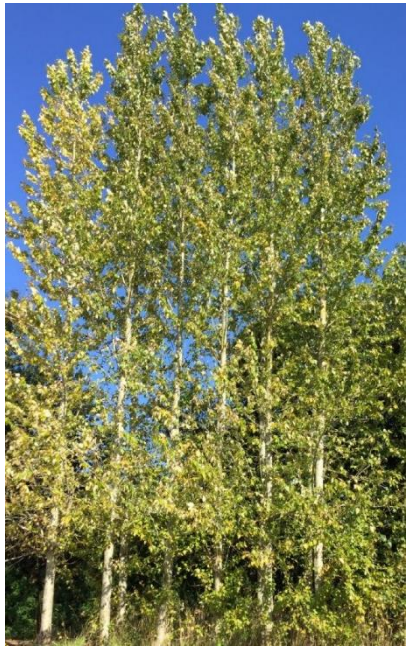


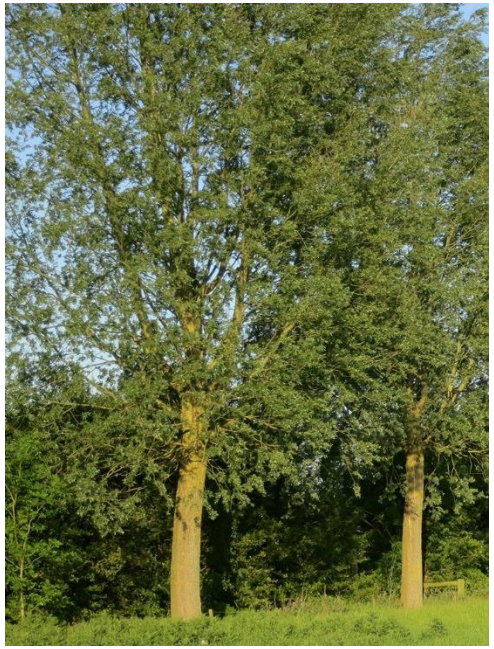






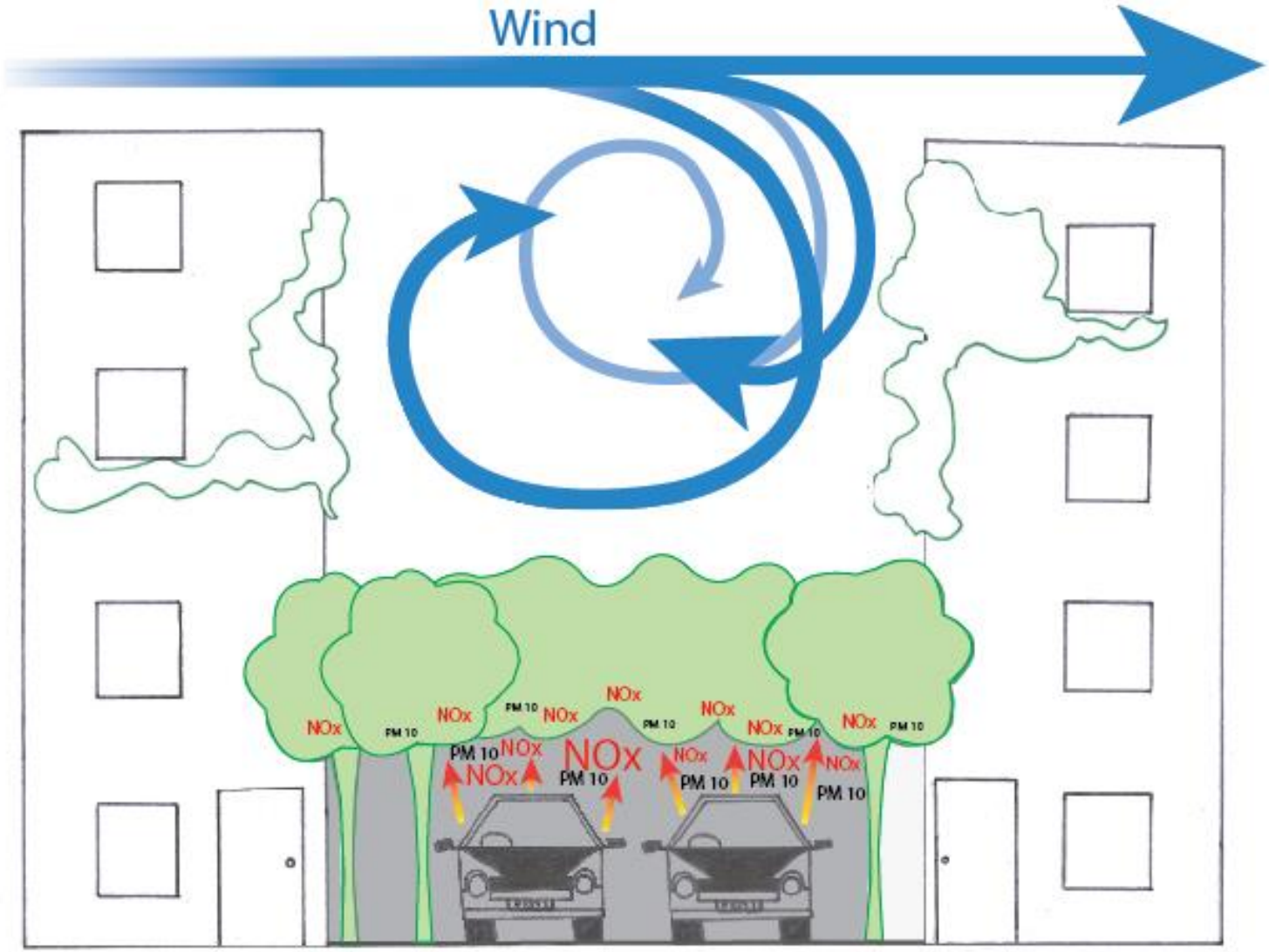
Are there good and bad trees to plant for improving air quality?





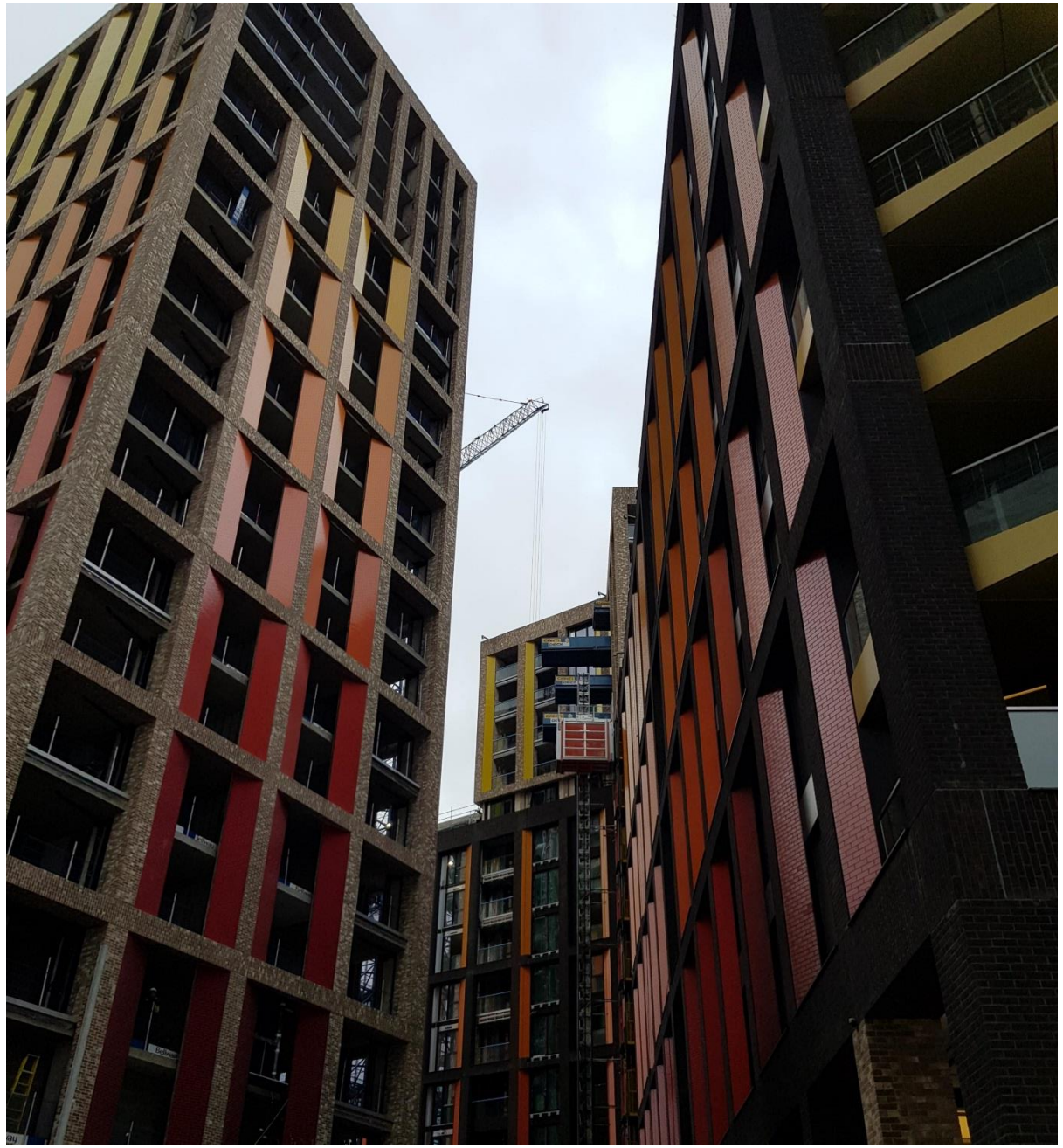
Circumstances where planting exacerbates effects of pollution

Are there optimal and sub optimal arrangements of planting?

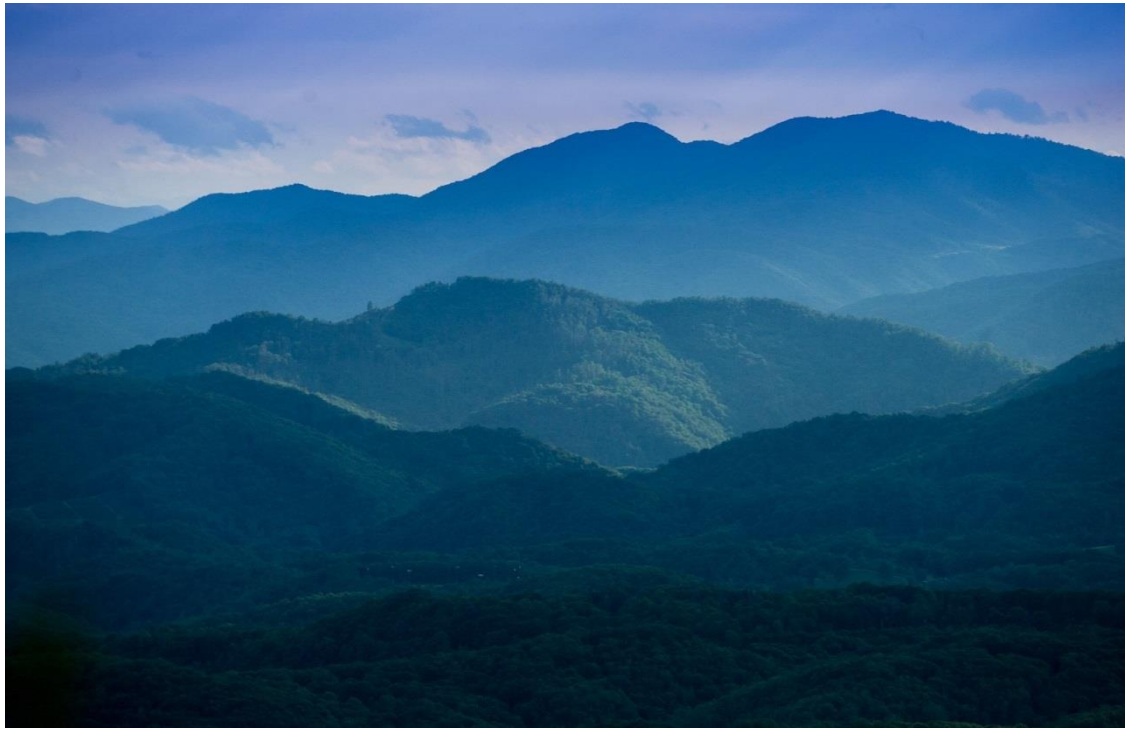

Wind
NOx
PM 10

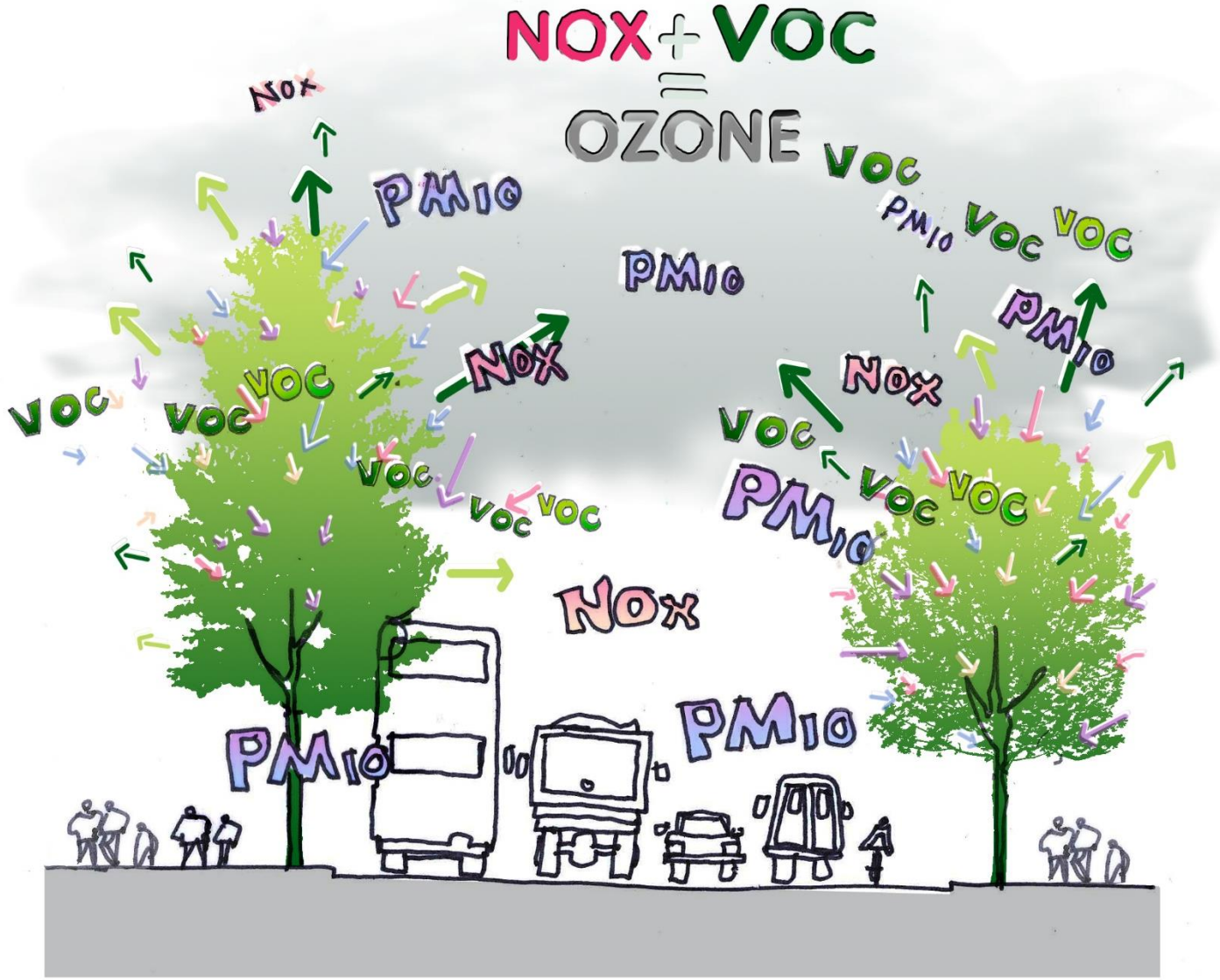
Worst Development Scenarios : Street Canyons


Waitrose



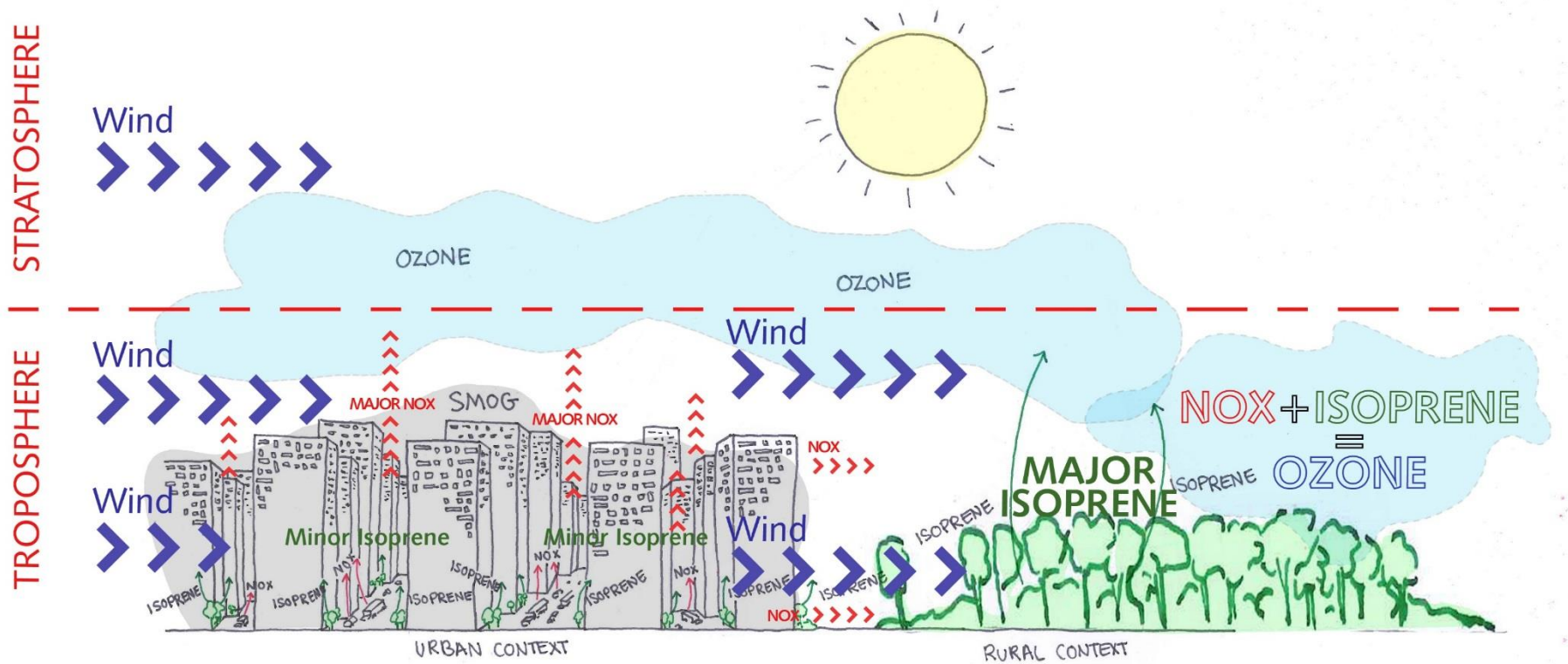
Can trees naturally worsen the effects of pollution?




NOX + VOC
=
OZONE
NOx
PM10
VOC
NOx
VOC
VOC
VOC
VOC
VOC
NOx
PM10
PM10
VOC
VOC
VOC
PM10
NOx
VOC
VOC
VOC
PM10
NOx
PM10
PM10

All plants synthesise reactive VOCs and release to atmosphere

- All trees release biogenic VOCs
- Isoprene C5H8 191, 2-methyl-1,3butadiene
- Produced by biogenic (trees) and anthropogenic (cars) sources
- In London 50% of Isoprene is due to vegetation on warm days
- Biogenic VOCs produce Ozone
- This is a delayed reaction so effect can be downwind
- Biogenic VOCs account for 10% of ozone concentrations within and downwind of urban areas
- Ozone production increases with temp so global warming will exacerbate problem


STRATOSPHERE
TROPOSPHERE
Wind
Wind
Wind
Wind
Wind
OZONE
OZONE
MAJOR NOX
SMOG
MAJOR NOX
NOX
Minor Isoprene
Minor Isoprene
ISOPRENE
NOX
NOX
MAJOR ISOPRENE
NOX + ISOPRENE = OZONE
URBAN CONTEXT
RURAL CONTEXT

Do plants have the Ability to deal with extreme pollution events

Methods of Assessing Acceptable Thresholds of Gaseous Pollution

- Hourly Objective : Concentration of NO2 in the air. Max allowable = 200ugm-3 with no more than 18 exceedences per year
- Annual objective : Concentration of NO2 averaged over a period of a year = 40ugm-3
- Incidence of extreme winter events is increasing while summer excedences are diminishing

Source : Air Quality Expert Group: Nitrogen Dioxide in the United Kingdom

EXTREME EVENTS

Conclusions

- Most effective means of tackling air quality is by reducing output from primary source
- Trees / vegetation can have a positive effect on mitigating pollution
- Worst effects are localised, i.e roadside and in street canyons
- The level of mitigation offered can be increased through choice of plant and by careful selection of correct planting position.

Dealing with problem at source, future of cars

2017

= 50 years

2067

Transportation 2067