

Access to nature

Here are links to the documents the Woodland Trust have produced:

<http://www.woodlandtrust.org.uk/mediafile/100098292/Healthy-Trees-Healthy-Places-WT-Jul-2013.pdf>

<http://www.woodlandtrust.org.uk/publications/2013/10/healthy-woods-healthy-lives/>

Richard Barnes, Woodland Trust presentation to Arboricultural Association conference

<http://www.trees.org.uk/Amenity-Conference-Presentations-2014#tabs-2-tab>

Kathleen Wolf's website at Washington Uni has several relevant pages, with a line for each bit of research:

http://depts.washington.edu/hhwb/Thm_StressPhysiology.html

http://depts.washington.edu/hhwb/Thm_Healing.html

http://depts.washington.edu/hhwb/Thm_Mental.html

A study of Toronto shows that adding 10 trees per city block makes residents healthier — by the same amount as raising their incomes \$10,000 per household.

<http://www.nature.com/articles/srep11610>

<http://ottawacitizen.com/news/national/planting-trees-in-the-city-makes-residents-healthier-study-shows>

Another sift and summary of health evidence in the Woodland Trust document about residential development and trees:

<http://www.woodlandtrust.org.uk/publications/2015/07/residential-developments-and-trees/>

Heat Island Effect

Heat Island Effect - The role of one large greenspace in mitigating London's nocturnal urban heat island by Kieron J. Doick, Andrew Peace, Tony R. Hutchings, June 2014, Land Regeneration and Urban Greenspace Research Group, Forest Research, Farnham, Surrey GU10 4LH, UK.

Highlights:

- Trees help regulate urban air temperatures and combat the urban heat island effect.
- We describe cooling of London's heat island by one large greenspace over 5 months
- Cooling of up to 4 °C over 440 m distance from the park was observed on single nights.
- The park cooled London when cooling was most needed, on warm still nights.

NHS and Public Health

There is mounting research evidence which backs up the case that the NHS Forest will help sites to realise the following, proven health, social, environmental and financial benefits:

<https://nhsforest.org/evidence>

Forests, trees and human health and wellbeing - Modern, sedentary lifestyles and stressful urban living are leading to high levels of poor health in Europe that medicine alone cannot combat. As a partner in the 'Forests, trees and human health and well-being' project, Forest Research explored how natural places and spaces contribute to, and could improve, the health and well-being of people in Europe.

<http://www.forestry.gov.uk/fr/INFD-66LJNL>

Regulation of the immune system by biodiversity from the natural environment: An ecosystem service essential to health, Graham A. Rook, Centre for Clinical Microbiology, Department of Infection, and the National Institute for Health Research and University College London.

Hospitals Biomedical Research Centre, University College London, London NW3 2PF, United Kingdom. Edited by Ruslan Medzhitov, Yale University School of Medicine, New Haven, CT, and approved October 1, 2013 (received for review July 23, 2013). It is about human immune system and the natural environment. He does not discuss trees in particular but rather the health benefits of green space. If you enjoy parasites, micro-organisms and dirt read on...

Further evidence that green space, street trees in particular, have a positive impact on human wellbeing, regardless of socio economic factors

http://www.islandpacket.com/2015/07/28/3855373_lauderdale-adding-10-trees-is.html?rh=1

NHS Forest is a project coordinated by the charity, the Centre for Sustainable Healthcare. Its main aim is to improve the health and wellbeing of staff, patients and communities through increasing access to green space on or near to NHS land.

Identifying the five aims of NHS Forest:

- Greening the NHS estates and planting 1 tree per employee (1.3 million trees in five years)
 - Improving health of staff, patients and communities through use of green space
 - Encouraging NHS to provide environmental benefits through their Estates (carbon offsetting)
 - Engaging people in and around healthcare with their immediate environments. Improving access to green space on or near NHS land.
 - Bringing together a range of professionals to produce woodland that includes use of art, food crops and mapping.
So encompassing a healing environment, providing a carbon sink and air conditioner and provision of preventative healthcare.
- **Studies of cholecystectomy patients in hospital found that they recovered more quickly with a view of trees and nature from their windows.** Ulrich, R.S., 1984. *View through a window may influence recovery from GP practice.* Science 224, 420-421
- **Hospital gardens can provide the following:**
 - Facilitate stress reduction which helps the body reach a more balanced state
 - Help a patient summon up their own inner healing resources
 - Help a patient come to terms with an incurable medical condition
 - Provide a setting where staff can conduct physical therapy, horticultural therapy, with patients
 - Provide staff with a needed retreat from the stress of work
 - Provide a relaxed setting for patient/visitor interaction away from the hospital interior

Cooper, M. C., 2005: *Healing Gardens in Hospitals*, The Interdisciplinary Design and Research e- Publication, 1(1), 1-27. cabeurl.com/6w.

- 'Future health – Sustainable places for health and well-being', CABE 2009
<http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe....>

Explores the fact that good design can create high quality, sustainable places that meet a wide range of goals.

Promotion of healthy lifestyles and physical activities as a method of effectively treating a number of conditions (depression, heart disease, diabetes or colon cancer).

Discusses modernising healthcare and providing healthy therapeutic environment, including provision of views to natural environment, exploitation of natural light, reduction of energy use. Quite generic approach discussed.

- IMPROVED COMMUNITY HEALTH
The British Heart Foundation has produced a good booklet as to the cost implications of physical inactivity.

<http://www.bhfactive.org.uk/userfiles/Documents/economiccosts.pdf>

Provides a lot of information on the costs of different health conditions.

- **Trees and woods can have a restorative and therapeutic effect on the mind.** Hartig, T., Evans G.W., Jamner L.D., Davis D.S., and Gärling T. (2003). 'Tracking restoration in natural and urban field settings.' *Journal of Environmental Psychology* 23, 109-123.

Read summary only which seemed to imply that the comparison was really 'natural' versus 'urban' settings and did not identify trees specifically.

- **Recent studies have looked at the beneficial effects of natural surroundings on children with Attention Deficit Hyperactivity Disorder.** Taylor, AF et al 2001 *Coping with ADD, The Surprising Connection to Green Play Setting*, *Journal of Environment and Behaviour*, Vol. 33, pp 54-77

Attention Restoration Theory (Kaplan, 1995) proposes that natural environments can assist attentional functioning. Humans have two types of attention: voluntary (where we deliberately pay attention) and involuntary (does not require effort). Certain elements in the environment draw on our involuntary attention: 'strange things, moving things, bright things, pretty things, leaves blowing in the wind etc'. Reliance on these to help with the rest and recovery of fatigued directed attention, giving directed attention to chance to rest.

Optimal levels of attentional functioning are essential for all children (not just those suffering ADD) so that they maximize learning and achievement in school. Thus, all children's attentional functioning may benefit from something as inexpensive and direct as incorporating vegetation into places where children live, learn, and play

- **Trees have been found to enhance mood, improve self esteem and lower blood pressure. Research in the Netherlands and Japan indicated that people were more likely to walk or cycle to work if the streets were lined with trees and live longer and feel better as a result.** Van den Berg, A.E., Koole S.L., and van der

Wulp N.Y. 2003. *Environmental preferences and restoration: (how) are they related?* Journal of Environmental Psychology 23, 135-146.

- **Two reports, sponsored by RSPB, published in 2004 and 2007 outlined the benefits to physical and mental health arising from contact with the natural environment. These included the reductions in obesity, heart disease, diabetes, cancer, stress, ADHD, aggression and criminal activity, amongst others.** Bird, W (2004) 'Natural Fit', RSPB - www.rspb.org.uk/Images/natural_fit_full_version_tcm9-133055.pdf Bird, W (2007) 'Natural Thinking', RSPB - www.rspb.org.uk/Images/naturalthinking_tcm9-161856.pdf

Interesting point on Nature and Children:

Children who spend time in woodland with friends or alone without parental supervision are the most likely to visit and enjoy woodland as an adult. These adults are also more likely to describe woodland as "magical" and are less anxious when visiting woodland alone. The critical age of influence appears to be before 12yrs. Before this age contact with nature in all its forms but in particular wild nature appears to strongly influence a positive behaviour toward the environment. The sense of freedom of unstructured play that occurs in nature creates a source of independence and inner strength that can be drawn upon during stressful situations for the rest of their life.

From: Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism¹ by Nancy M. Wells and Kristi S. Lekies.

- **Environmental volunteering, including tree planting, can be as effective as aerobics in improving fitness. Independent evaluation of BTCV's Green Gym concluded that overall the physical health status of volunteers significantly improved, with 99% of participants reporting enhanced health and confidence.** Yerrell, P. 2008 'National Evaluation of BTCV's Green Gym.' Oxford Brookes University www2.btcv.org.uk/display/greengym_research
- **Dissertation identifying the feasibility of the NHS Forest and the healing properties of the creating of greenspace on NHS Estates.** Ian Higgins, MA [The NHS Forest Dissertation](#)
 - NHS Forest Conference 2015: How to convince health professionals green space is a good idea or Going from blackberry to Blackberry – and back again: Carl Petrokofsky
<http://nhsforest.org/sites/default/files/NHS%20Forests%20Conference%2028%20Sept%202015%20PH%20England.pdf>
 - Activities to encourage engagement in your NHS Forest, Georgina Smith (2015 NHS Forest Conference)
<http://nhsforest.org/sites/default/files/NHSFOREST%20Glocs%20Care.pdf>
 - <http://nhsforest.org/sites/default/files/NHS%20Forest-%20presentation.pdf>
 - **Conference Proceedings from the 2011 ICF - Trees, people and the built environment.** Sections on Promoting green networks and human wellbeing,

management of the urban forest and the value of communities in successful urban greening among other chapters are relevant to the NHS Forest.

[www.forestry.gov.uk/pdf/FCRP017.pdf/\\$FILE/FCRP017.pdf](http://www.forestry.gov.uk/pdf/FCRP017.pdf/$FILE/FCRP017.pdf)

- **Forests, Trees and Human Health** Nilsson, K.; Sangster, M.; Gallis, C; Hartig, T.; de Vries, S.; Seeland, K; Schipperijn, J. Eds. 2011. Springer

Book explores the link between modern lifestyles and increasing levels of chronic heart disease, obesity, stress and poor mental health is a concern across the world. The cost of dealing with these conditions places a large burden on national public health budgets so that policymakers are increasingly looking at prevention as a cost-effective alternative to medical treatment. Attention is turning towards interactions between the environment and lifestyles. Exploring the relationships between health, natural environments in general, and forests in particular, this groundbreaking book is the outcome of the European Union's COST Action E39 'Forests, Trees and Human Health and Wellbeing', and draws together work carried out over four years by scientists from 25 countries working in the fields of forestry, health, environment and social sciences. While the focus is primarily on health priorities defined within Europe, this volume explicitly draws also on research from North America and elsewhere and will have relevance worldwide. A state-of-the-art analysis of the global research on the topic of forests and human health, a key contribution of the book is its synthesis of material across both disciplines and nations, providing a vital reference for researchers in forestry, health, natural resource management and environmental policy. Currently the only unified body of work on this topic, the book will also be an important tool for those working in both health and environment policy and practice.

- **Trees and Woodlands, Nature's Health Service.** Liz O'Brien 2005 Forest Research

Identifies key government priorities for health with suggestions as to how organisations such as the Forestry Commission can help people to chose healthier lifestyles. Reviews past and current research.

- Woodlands as restorative environments
- Specific meaning for people of woodland and individual trees; they are seen as representing nature, particularly in the urban environment. Link between veteran trees and the past, present and future.
- Trees and woodlands are a source of stories, legends and myths dating back thousands of years.
- Woodlands can screen out noise, for example, from nearby traffic and also have the ability 'to absorb' large numbers of people without seeming crowded.
- Woodlands offer a range of activities for all. An attractive environment may encourage people to maintain their activities in the long term.
- Woodlands are inexpensive

- **Why Nature should not be seen as an expensive add on!** A good article relating to the Ecosystems Assessment report in the Guardian. <http://www.guardian.co.uk/sustainable-business/nature-heart-economic-soc...>
- A Dose of Nature: addressing chronic health conditions by using the environment
http://nhsforest.org/sites/default/files/Dose_of_Nature_evidence_report_0.pdf
- Mind has demonstrated that: **Ecotherapy would contribute to three of the government's six key priorities set out in its Public Health White Paper:** increase exercise, improve mental health and reduce obesity. The report provides evidence of studies confirming that participating in green exercise activities provides substantial benefits for health and well-being. *Ecotherapy could contribute to reducing the £338 million that antidepressant prescription costs the public health service.*
- **Populations living in greener environments have lower levels of income related health inequality.** Mitchell R., Popham F., 2008 *Effect of exposure to natural environment on health inequalities: an observational population study.* The Lancet, 372 (9650). pp 1655-1660
- Great Outdoors:How Our Natural Health Service Uses Green Space To Improve Wellbeing
An action report by the Faculty of Public Health
http://www.fph.org.uk/uploads/r_great_outdoors.pdf
- Direct and Indirect health benefits of urban parks: <http://www.ifpra.org/images/park-benefits.pdf>
Benefits for staff of greenspace/ plants within your office <http://metro.co.uk/2013/09/16/sick-building-syndrome-get-some-air-4019902/>
- *Street trees have been found to have decreased the risk of negative mental health outcomes.* Research note: Urban street tree density and antidepressant prescription rates—A cross-sectional study in London, UK. Taylor MS et al. Journal of Landscape and Urban Planning 136 (2015) 174-179
- **Access to woodland is not only important for health benefits through exercise but also makes visitors feel 'happy', 'relaxed' and 'close to nature'** Coles R.W. and Bussey S.C. 2000, 'Urban forest landscapes in the UK - progressing the social agenda.' Landscape and Urban Planning 52, pp181- 8
- **It has been estimated that doubling the tree cover in the West Midlands alone would reduce mortality as a result of poor air quality from particulates by 140 people per year.** Stewart, H., Owen S., Donovan R.,

MacKenzie R., and Hewitt N. (2002). 'Trees and Sustainable Urban Air Quality'. Centre for Ecology and Hydrology, Lancaster University

- **Woodland is an important leisure resource. Benefits from public access were estimated in 2003 to be £392m per year in GB (£447m at 2007/08 prices).** CJC Consulting (2009), 'The Value of Benefits Arising from Trees and Woodland in the UK'
- **The case for trees:** in development and the urban environment. Demonstrates specific benefits of trees, with a number of examples across a range of different sites. The Forestry Commission has produced this useful document aimed at urban planners outlining the importance of trees: www.forestry.gov.uk/forestry/INFD-87YEK2
- Green Spaces 'can save NHS billions'. Links also to Natural Englands 'Visit Woods' website:

http://nhsforest.org/sites/default/files/Dose_of_Nature_evidence_report_0.pdf

- Human wellbeing can strengthen case for conservation: <http://www.bbc.co.uk/news/science-environment-20713185>
- Top doctor back 'garden gym' idea <http://www.bbc.co.uk/news/science-environment-26871970>

Pollen

Spellerberg, I.F, Eriksson, N.E, Crump, A. (2006) '**Silver Birch (*Betula pendula*) Pollen and Human Health: Problems for an Exotic Tree in New Zealand**', Arboriculture & Urban Forestry, July 2006, 32 (4)

- Discussion of the human health problems associated with Silver Birch pollen from street trees in a temperate climate. Main allergic symptoms identified as seasonal hayfever, asthma and food allergies (oral allergy syndrome). Authors recommend a precautionary approach; increased awareness of health-related problems and tree removal.

Arnold, E, Strobach, M.W, Warren, P.S. (2014), '**Allergenic Potential of Street Trees in Boston, Massachusetts**', In book: Human-Environmental Interactions in Cities: Challenges and Opportunities of Urban Land Use Planning and Green Infrastructure, Chapter: 7, Publisher: Cambridge Scholars, Editors: Nadja Kabisch, Neele Larondelle, Angela Reeve, Martina Artmann, pp.115–141

- Analysis of Boston's street tree population regarding the allergenic potential of its trees in relation to specific species. Conduction of a pollen dispersion model for *Quercus* using the Quick Urban & Industrial Complex (QUIC) modelling system over a small area of the urban environment (1.2qkm).

Food Production

Melville, R (1944) '**Ailanthus, Source of a Peculiar London Honey**', *Nature*, 154 (3916): pp. 640-641

- A short article on the analysis of a honey sample, green/brown in colour, made in Kensington in close proximity to Kensington Gardens. Investigation of the pollens via dilution in water and sedimentation showed that 44% of the total came from *Ailanthus altissima* with the second most common being *Castanea sativa*.

Urbanbees.co.uk

- Urban Bees are a charitable organisation who work to highlight the situation of bees within London, raising awareness of challenges affecting their survival through the organisation of activity and educational days and distribution of information. The group promote the planting of plants and trees by private and public bodies which will have maximum benefit for the bee population, providing forage for as long a time frame as possible throughout the year. Urban Bees are partnered with several other charitable organisations including Wild About Roofs, The Honey Club and The London Wildlife Trust.

Piner, A.E, Bradley, L.K, Hooker, W.E, Sherk, J.T, (2013), '**Permaculture Solutions for an Urban Community Garden, Poster Board #061**', ASHS Annual Conference

- An analysis of methodologies for improved quality and sustainability of urban community gardens. Key foci – Energy efficiency, Water efficiency, Perennials, Compost, Shade and Signage.

Macedo, J.D, Dao, H, Huck, M, Gialtouridis, A, McCauley, S (2012), '**Edible Sustainable Landscaping at Clark University**',

- Replacement of a grass lawn with an edible treescape to reduce water and maintenance requirements of an area of campus, providing habitat for animals and food for pollinators, wildlife and humans. Also observed staff and students responses to the scheme – increase the university's approach to sustainability and encourage behavioural change.

Clark, K. H & Nicholas, K.A (2013) '**Introducing Urban Food Forestry: A multifunctional approach to increase food security and provide ecosystem services**', *Landscape Ecology*, 11/2013 28(9)

- Examination of the potential of food trees to function meaningfully as part of urban sustainable development and proposal of a multifunctional approach combining elements of urban agriculture, urban forestry and agroforestry.

Nicholas, K (2013) **'From Urban land Grabs to Urban Food Forestry: Land Use Decisions and Climate Impacts in Food Systems Across Scales'**, 98th ESA Annual Convention 2013

- A critique of Urban Food Forestry phenomenon, constraints and requirements etc. and a case study on UFF in Burlington, Vermont – ability to meet food demands.

The Urban Orchard Project – www.theurbanorchardproject.org

- Charity to plant new orchards, restore old orchards, promote their use and cultivation. Providing training and event days to strengthen communities and sustainably develop the urban environment.

Mosely, D. Ambrose-Oji, B. Carter, C. Lawrence, A (2015 May) **'UK Planning Systems: Integrating Woodlands and Trees'**,

- Highlights the need for a change in spatial planning systems across the UK from principle land-users such as the Forestry Commission to adapt to use of Urban and Peri-Urban landscapes.

Pollution

Trees – Relief for the City. Hiemstra, Schoenmaker – van der Bijl/Tonneijck – Plant Publicity Holland, Boskoop. www.pph.nl

Further reading and useful website list at the end.

Highlights - Effectiveness of trees and plants for improving air quality – page 26, has a really useful table on PM10S/Nox /Ozone and VOC emissions by species..

Loads of good snippets – like, planting trees for shade can reduce VOC emissions from hot petrol tanks.

Mitchell Maher and Kinnersley – in Environmental Pollution 2010. Maher' s experiment was the subject of the BBC programme Trust me I'm a Doctor.

More than just a breath of fresh air by Mike Moore 27 June 2015 New Scientist looking at trees for air quality

Trees for air quality review by Islington Environmental Health Team.

It is a review of papers investigating planting, primarily tree but also shrubs, as a way of countering the effects of particulate matter pollution. The article also includes recommendations for species choice and looks at the role of other types of green infrastructure i.e. green walls and a brief discussion of volatile organic compounds (VOC's) and trees.

Article in the conversation by Prof Rob McKenzie about urban air quality and trees

https://theconversation.com/do-trees-really-help-clear-the-air-in-our-cities-48202?utm_medium=email&utm_campaign=Latest+from+The+Conversation+for+November+4+2015+-+3753&utm_content=Latest+from+The+Conversation+for+November+4+2015+-+3753+CID_7b4ddfed3a82dcaf63efb6bd28afd720&utm_source=campaign_monitor_uk&utm_term=Do%20trees%20really%20help%20clear%20the%20air%20in%20our%20cities

URL if the link above doesn't work is: <http://tinyurl.com/nn3zcmk>

VOC's/Air Quality and Particulates and gases

Estimating the removal of atmospheric particulate pollution by the urban tree canopy of London – Tallis et al 2011

Evidences to support mitigation potential against atmospheric particulate pollution. GLA estimate current and future PM(10) deposition to urban tree canopy. Modelling approach was used based on Urban Forest Effects Model (UFORE). Urban canopy of GLA is estimated to remove between 852 and 2121 tonnes of PM(10) annually: representing 0.7% and 1.4%. Estimates of PM(10) removal taking in account a planned increase in tree cover from the current 20% to 30% of GLA land area suggest deposition of 1109-2379 tonnes (1.1%-2.6% removal) by year 2050. Evidence provided suggest targeting tree planting in the most polluted areas of the GLA and particular use of street trees would have greatest benefit to future air quality. The increased deposition would be greatest if a large proportion of coniferous to broadleaves trees were used at such sites.

Notes:

- Estimates for the UK indicate that short-term exposure to the levels of particulate matter of less than 10×10^{-6} m in aerodynamic diameter (PM10) led to an additional 6500 deaths and 6400 hospital admissions in 2002 (AQEG, 2005)
- The UK Department of Health also estimates that 1.9% of urban deaths can be attributed to PM10 pollution (COMEAP, 1998)
- Large tree leaf areas increases uptake of fine particles by diffusion, the canopy area and structure (i.e. tree species), concentration of particles in the airstream, particle size distribution, and windspeed are all important factors in determining particle uptake by vegetation (see a full discussion in Beckett, Freer-Smith, & Taylor, 2000c)
- For both models a coniferous canopy sited in the most polluted areas resulted in the greatest capture of PM10 ranging from 161.5 to 1653.8 kg ha⁻¹ y⁻¹
- Implementing a 30% canopy cover under scenario 1 (S1) would result in an increased annual capture of 18%

What impact do trees have on air pollutant concentrations? – DEFRA

DEFRA produced pdf article explains basics about trees and air pollutions both good and bad, cites some research papers but is not a research journal itself.

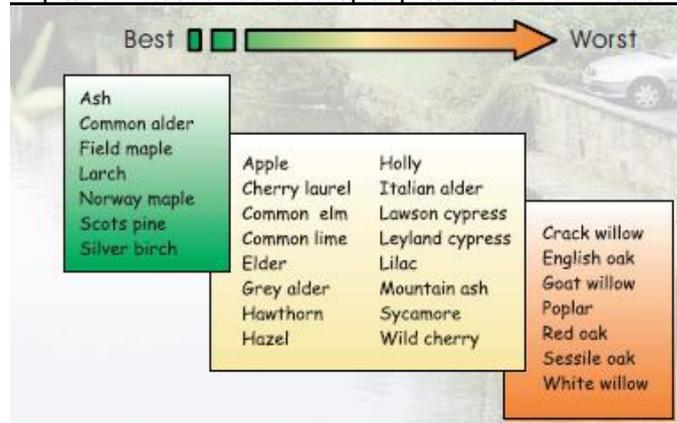
[http://laqm.defra.gov.uk/documents/What impact do trees have on air pollutant concentrationsv1.pdf](http://laqm.defra.gov.uk/documents/What%20impact%20do%20trees%20have%20on%20air%20pollutant%20concentrationsv1.pdf)

Trees & Sustainable Air Quality – Lancaster University Lecture Notes

Identifies trees good and bad for VOC's, talks about which species good for carbon storage.

Some good diagrams although a bit old!

<http://www.es.lancs.ac.uk/people/cnh/UrbanTreesBrochure.pdf>



Health Benefits of Street Trees – Forestry Commission 2011

General review does not focus on any particular country but draws on a wide pool of research publications in English considered relevant to the whole of UK

[http://www.forestry.gov.uk/pdf/Health_Benefits_of_Street_Trees_29June2011.pdf/\\$FILE/Health_Benefits_of_Street_Trees_29June2011.pdf](http://www.forestry.gov.uk/pdf/Health_Benefits_of_Street_Trees_29June2011.pdf/$FILE/Health_Benefits_of_Street_Trees_29June2011.pdf)

..... 4.4 Reduce air pollution

There is a lot of evidence of trees reducing air pollution and of the economic benefits of this (Jim and Chen, 2008; Nowak et al., 2006; Nowak et al., 2002; Nowak et al., 2007; Peper et al., 2007; Tiwary et al., 2009). Economic benefits are usually estimated in terms of investment cost necessary if the air was instead purified by technological means¹². Street trees improve air quality in five main ways (Peper et al., 2007):

- Absorbing gaseous pollutants (ozone [O₃], nitrogen dioxide [NO₂]) through leaf surfaces
- Intercepting particulate matter (e.g., dust, ash, dirt, pollen, smoke)
- Reducing emissions from power generation by reducing energy consumption
- Releasing oxygen through photosynthesis
- Transpiring water and shading surfaces, resulting in lower local air temperatures, thereby reducing O₃ levels

Improving Air Quality – Forestry Commission 2006 Summary Guidance/Background Notes

<http://www.forestry.gov.uk/fr/urgc-7edhgh>

Research case study: The use of vegetation to mitigate particulate pollution has been recognised for a number of years. Forest Research used an integrated modelling approach that utilised air dispersion (ADMS-Urban) and particulate interception (UFORE) to predict the PM₁₀ concentrations both before and after greenspace establishment, using a 10 x 10 km area of East London Green Grid (ELGG).

The corresponding health benefits, in terms of premature mortality and respiratory hospital admissions, as a result of the reduced exposure of the local population were then modelled. It was found that PM₁₀ capture from the scenario comprising 75% grassland, 20% sycamore maple (*Acer pseudoplatanus* L.) and 5% Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) was estimated to be 90.41 t yr⁻¹, equating to 0.009 t ha⁻¹ yr⁻¹ over the whole study area. The human health modelling estimated that 2 deaths and 2 hospital admissions would be averted per year.

A CFD study on the effectiveness of trees to disperse road traffic emissions at a city scale – Jeanjean 2015

<https://ira.le.ac.uk/bitstream/2381/32999/4/1-s2.0-S135223101530248X-main.pdf>

CFD (Computational Fluid Dynamics) simulations of air-pollutant concentrations, focusing on interaction with trees and wind flow dynamics. Studied based on buildings in City of Leicester.

It was found that in effect, trees have a regionally beneficial impact on road traffic emissions by increasing turbulence and **reducing ambient concentrations of road traffic emissions by 7% at pedestrian height** on average. This was an important result given that previous studies generally concluded that trees trapped pollution by obstructing wind flow in street canyons. Therefore, this study is novel both in its methodology and subsequent results, highlighting the importance of combining local and regional scale models for assessing the impact of trees in urban planning.

Londons pollution-busting trees valued at £6.1 billion in new survey – iTree London Survey

Key facts:

- storm water alleviation = 3,414,000m³ per annum worth £2.8 Million
- carbon storage = 2,367,000t per annum worth £146.9 Million
- pollution removal = 2241t per annum worth £126.1 Million
- It would cost £6.1bn to replace all of London's tree canopy

Estimated 2,367,000 tonnes (approx. 15t/ha) of carbon is stored in London's trees with an estimated value of this function to be £147 million.

Air-pollutant-Philic Plants for Air Remediation – Takahashi & Morikawa 2012<http://dx.doi.org/10.4236/jep.2012.310153>

Japanese study based on two decades reviewing air-pollutant philic plants that can grow with air pollutants as the sole nutrient source. Target air pollutant has been atmospheric nitrogen dioxide (NO₂).

Work includes variation in plants abilities to mitigate air pollutants among naturally occurring plants, genetic improvement of plants' abilities to mitigate pollutants, and plant vitalization effect of NO₂.

During the study on air-pollutant-philic plants, they unexpectedly discovered that prolonged exposure of plants to a sufficient level of NO₂ activates the uptake and metabolism of nutrients that fuel plant growth and development. We named this phenomenon "the plant vitalization effect of NO₂" (PVEON).

Top trees for NO₂ reduction:

- Eucalyptus viminalis
- Populus Nigra
- Magnolia kobus
- Robinia pseudoacacia
- Eucalpytus grandis
- Eucalpytus globulus