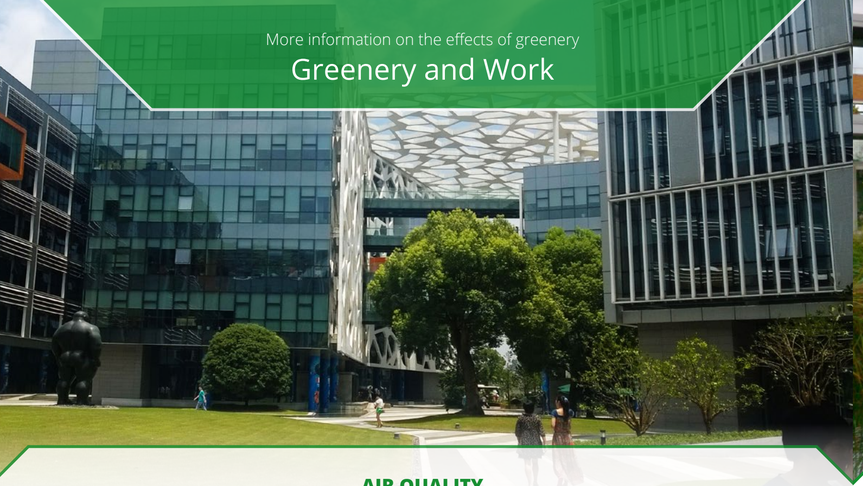
More information on the effects of greenery

Greenery and Work



AIR QUALITY

The major air pollutants in urban areas (nitrous oxides (NO_x), particulates (PM10/PM2.5) and volatile organic compounds such as benzene) come from industry and traffic. Long-term exposure to these substances leads to lung problems and cardiovascular disease. Although air quality at most locations in the Netherlands complies with standards, this does not mean the risk is eliminated entirely. According to recommendations by the WHO, continuing to tighten the PM2.5 standard in the Netherlands would extend the average lifespan by 3 months, reduce premature deaths by 600 and lower sick days by 1.5 million per year. In industrial areas, dense traffic is often a local source of particulate matter (soot) and nitrous oxides. Industrial pollutants are generally released through chimneys, and dissipate into higher atmospheric layers.

HOW GREENERY WORKS

- All forms of vegetation help remove particulates and other pollutants from the air. Gaseous pollutants are absorbed by leaves, and particulates are filtered passively. [1]
- Plants can also improve indoor air quality, particularly by trapping volatile organic compounds (VOCs) such as benzene and formaldehyde emitted by construction materials. [2]
- Trees are most effective due to their size and volume; the average city tree traps 100 grams of particulate matter per year. [3]
- Other types of greenery also help purify the air: one square metre of ivy collects 4-6 grams of particulate matter per year, and a stonecrop roof catches 0.15 g/m^2. [4]
- Dense vegetation can also be used to shield neighbouring residential areas and sensitive buildings such as schools and hospitals against the pollution caused by busy traffic on business estates. [5]
- Staff in office spaces that contain plants rate the air quality more highly. [6]

RECOMMENDATIONS

- Increase the amount of roadside vegetation to raise filter capacity. Large and healthy trees are the most effective, so be sure to provide proper growth conditions.
- Evergreen conifers are most effective at trapping particulates; broad-leaved trees with large, fuzzy or sticky leaves are a good alternative. Trees with flat, broad leaves are most suitable for absorbing ozone and nitrous oxide. Species that secrete large amounts of volatile organic compounds should be avoided.
- Large green areas help improve regional air quality.
- Shade in car parks reduces the evaporation of fuel from fuel tanks.
- Due to the importance of environmental air exchange on air quality, vegetation around industrial and business estates should be planted to allow for effective air circulation.
- Dense vegetation at the edge of an estate can help shield residential areas and sensitive buildings (schools, hospitals, aged care facilities) against pollution from local sources (traffic especially).
- In working environments, use species that purify the air effectively, such as the Peace Lily (Spatiphyllum), Calatheas, Chlorophytum, Areca Palms, Dracaena and ferns.

Image: [illegible]plantendoen.nl

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6. *Nieuwenhuis, M., Knight, C., Postmes, T., Haslam, S., 2014. The Relative Benefits of Green Versus Lean Office Space: Three Field Experiments Journal of Experimental Psychology: Applied, 2014, Vol.20(3), pp.199-214.*

Compilation: Wageningen University & Research: J.A. Hiemstra, S. de Vries and J.H. Spijker.

Giving greenery its due

Greenery and Work

FURTHER INFORMATION

There are many real-life applications that illustrate and demonstrate the added value of vegetation.
Useful sources of information include:

www.thegreencity.com
www.wur.nl
www.royalfloraholland.com
www.groenkennisnet.nl

Specific questions on topics such as reference projects, research results, etc. can be sent directly to **joop.spijker@wur.nl**.

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A summary of the positive effects of greenery on well-being in working environments

Greenery and Work

Greenery in and around offices and other working environments is good for both the indoor and outdoor climate, and has a positive effect on the health and general well-being of employees and visitors. It aids concentration, helps reduce stress and increases staff productivity.
This document provides information on the benefits of greenery in relation to work and well-being, including references to scientific literature. It concludes with some tips on how to ensure the successful and beneficial inclusion of greenery.

WHAT DOES GREENERY DO?

- Plants in offices purify the air: they reduce concentrations of CO_2 and volatile organic compounds, keeping the air fresh and healthy.
- External vegetation reduces heat in and around buildings in the summer, lowering heat stress and reducing the need for air-conditioning.
- Green roofs and facades increase insulation capacity, reducing both heating and cooling expenditure.
- Office plants release water vapour which humidifies the air, reducing headaches and improving concentration.
- 'Green views' also boost concentration, and aid recovery from stress.
- Green environments encourage people to undertake activities such as a lunchtime walk, keeping staff alert and healthy. Long periods of sitting adversely affect health.

APPLICATIONS

- Green roofs and facades.
- Green indoor office walls.
- Indoor plants in the company restaurant, central spaces and offices/ conference rooms.
- Green dividing walls, mobile planters.
- Attractive landscaping of the office premises, including green borders, hedges and trees
- Companies can include the use of vegetation in their sustainability policy, projecting a 'greener' image.

PROVEN SUCCESS

- A study in Norway showed that office workers without an outdoor view from their desk were five times more likely to put a plant in their office than those with a view. [1]
- A Danish study revealed that office staff with a 'green view' were happier with their view. This happiness in turn correlated positively with (self-reported) productivity levels. [2]
- In an experimental working environment study, employees with a view of plants completed a concentration test 19% faster than those in a room without plants. [3]

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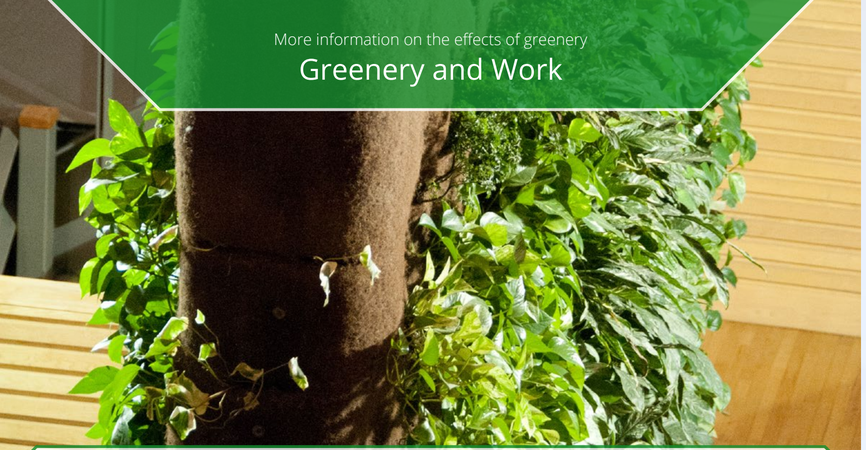

TEMPERATURE

Higher percentages of built-up and surfaced areas generally result in higher temperatures (the 'heat-island' effect). This applies not only to cities, but also to industrial and business estates. The effect occurs in both metropolitan and provincial cities, and increases as built-up areas become denser. Measured in the Netherlands, maximum differences in ambient temperature due to the heat-island effect vary from one to several degrees, with peak values reaching around 8 °C and incidental values even exceeding 10 degrees.

Heat stress reduces productivity, and extreme values or long duration can affect the health of staff. Research has shown that 35% of urban areas in the Netherlands already experience heat stress at least 7 days per year. Rising urban density and global warming will increase the frequency of these heat-stress periods.

Areas with lots of greenery stay cooler than surfaced city areas, and this cooling effect on the environment helps reduce urban warming.

HOW GREENERY WORKS

- Greenery provides cooling by blocking solar radiation (i.e. providing shade) and aiding evaporation; a 10% increase in urban vegetation reduces the heat-island effect in the relevant zones by an average of 0.6 °C. [1]
- Green roofs (potentially in combination with green facades) lower temperatures in large buildings and factories, reducing the associated costs of cooling or production losses. [2]
- Shade trees above car parks reduce fuel evaporation from tanks, and keep car interiors cooler. [3]
- Planting vegetation helps reduce environmental heat stress, and is most effective when the cooler air coming from the greenery can flow freely through the area. [4]
- Greenery in industrial areas and business estates also helps to trap CO_2 and reduce global warming. [5]

RECOMMENDATIONS

- Green roofs atop offices and factories reduce heating and cooling costs.
- More vegetated surfaces and planting trees on nature strips in industrial and business estates improves the living environment by helping to reduce the heat-island effect.
- Planting shade trees in and around car parks creates a comfortable outdoor environment, and helps cool car interiors.
- More large-scale green landscaping in industrial and business estates helps create a more pleasant climate in general.

Sources:

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Compilation: Wageningen University & Research: J.A. Hiemstra, S. de Vries and J.H. Spijker.

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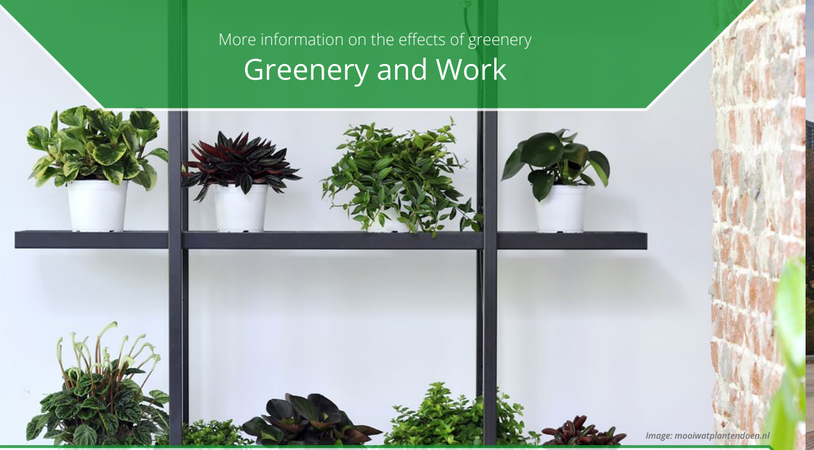

Image: mooiwatplantendoen.nl

PHYSICAL ACTIVITY

A lack of physical activity (and, by extension, obesity) is a key risk factor for health. It is the largest cause of illness after smoking. Obesity increases the risk of diabetes and cardiovascular disease.

According to Dutch health standards, one-third of adults do not get enough physical activity (i.e. activity that is considered at least 'moderate').

Until recently, no distinction was drawn between light physical activity and sedentary behaviour (e.g. sitting). However, there is increasing evidence that sedentary behaviour is a risk factor in itself; sitting is even being called 'the new smoking'.

HOW GREENERY WORKS

- Attractive green outdoor areas encourage employees to go outside for a short or long walk during breaks. [1]
- These same areas can also be used for 'walking meetings', which help boost creativity. [2]

RECOMMENDATIONS

- Create attractive green surroundings suitable for walks.
- Create a company culture that encourages outdoor walks during breaks.

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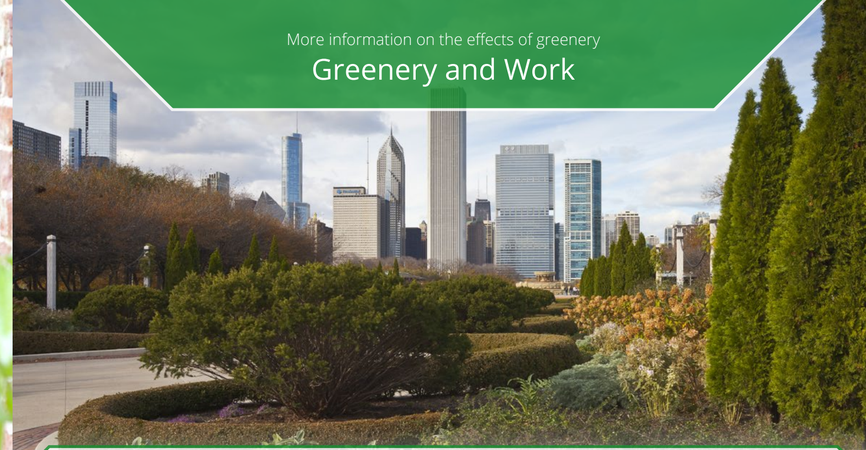

JOB SATISFACTION & PRODUCTIVITY

Infectious diseases used to be the primary cause of sickness absence. Nowadays however, they have been replaced by lifestyle-related conditions such as cardiovascular diseases, and conditions related to depression and anxiety. Chronic stress is a key risk factor in this regard. In addition to physical health, job satisfaction is also important, which includes satisfaction with the physical and other elements of the working environment. Stress (including job-related stress) can lead to a variety of problems, including psychological conditions. 'Burnout' and other psychological conditions top the list of work-related illnesses. According to the Netherlands Organisation for Applied Scientific Research (TNO), excessive workloads and work difficulty were responsible for 7.5 million sick days in 2014. Plants in the workplace can help prevent and reduce these problems.

HOW GREENERY WORKS

- Plants in office spaces reduce stress and improve the ability to concentrate.[1]
- Office plants increase workplace satisfaction. [2]
- Green office views are also associated with lower stress, which can also be influenced by levels of daylight. [3]
- The availability of green outdoor areas that can be used during breaks is also associated with both reduced stress[4] and higher workplace satisfaction. [5]
- Research in the Netherlands and Great Britain showed a 15% increase in productivity in office spaces containing plants. [6]

RECOMMENDATIONS

- Put plants in the workplace and in other locations frequented by employees (e.g. the company restaurant).
- Create views of outdoor greenery, from desks especially.
- Create pleasant green outdoor spaces that can be used by employees to relax and 'take some time out'.

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