

# GREEN & QUIET BRUSSELS

## ENVIRONMENTAL INJUSTICE IN OUTDOOR AIR POLLUTION

Inequality in exposure and in the impact on health and mortality of exposure to outdoor air pollution in the Brussels Capital Region

### MAIN CONCLUSIONS

1. Outdoor air pollution is an urgent problem that poses a threat to public health and that involves high costs.
2. Knowledge around the health risks of outdoor air pollution and its problematisation is limited and unevenly distributed in the population.
3. Socially vulnerable groups are least aware of the health risks of outdoor air pollution, while there are strong indications that they are the largest victims.
4. Policy on outdoor air pollution is mainly driven by the need to meet (international) standards; a policy that regards outdoor air pollution as a (social) health determinant would be much more ambitious.
5. Pollution measures should focus even more on tackling pollution at source, rather than trying to protect the population once pollution is a reality.
6. The problem of outdoor air pollution calls for more co-operation between and within different policy levels.
7. Policy should focus on better informing and raising awareness about the health risks of outdoor air pollution.

## ENVIRONMENTAL INJUSTICE IN OUTDOOR AIR POLLUTION

### INTRODUCTION

In Brussels, there are various environmental factors that influence the quality of the living environment, positively and negatively. Outdoor air pollution is an important factor that has a negative impact on the quality of the living environment and on the health of Brussels residents. There is a large consensus on the problematic nature of outdoor air pollution. However, the urgency of the problem has not yet been sufficiently translated into effective policy measures aimed at limiting the negative health impact of outdoor air pollution as far as possible.

The extent to which the Brussels population itself identifies outdoor air pollution as a health risk differs from one population group to another. Although scientific research shows that outdoor air pollution poses serious health risks, knowledge about it is unevenly distributed among the population. The problematisation of outdoor air pollution is limited to specific groups within Brussels society. Outdoor air pollution is not infrequently portrayed as an 'elite problem', which only keeps well-to-do sections of the population awake at night. Yet, according to our figures, it is a problem that particularly affects the most socially vulnerable groups within our society. This policy paper first attempts to provide an overview of the inequalities in outdoor air pollution, both in terms of exposure and in terms of health risks. In addition, the document also contains an overview of the current policy on outdoor air pollution and sets out suggestions for future policy.

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### METHODS

This memorandum is part of the research project Green&Quiet. The project was financed by Innoviris and carried out by researchers at Interface Demography of the VUB in association with KU Leuven. The project maps the relationship between living environment and health in the Brussels Region through a combination of quantitative and qualitative research methods. The objective of Green&Quiet is to investigate the quantitative relationship between positive environmental factors (the presence of public green spaces) and negative environmental factors (outdoor air pollution and noise pollution) in the immediate environment and health/mortality of the inhabitants of Brussels. Special attention is paid to the role played by social background

factors. On the basis of qualitative research, how various social groups differ from each other in terms of use, perceptions and beliefs about the living environment will also be mapped out.

The findings in this policy memorandum are supported by thorough empirical research based on available data. Socio-economic data and data on mortality were obtained by linking the Belgian census data from 2001 and register data on emigration and mortality during the period 2001-2016. In order to study the relationship between residential outdoor air pollution and mortality, environmental indicators were integrated into the linked census/register file by means of the residential address of each individual. Concentrations of outdoor air pollution were measured using high-resolution data from the Interregional Cell for the Environment (IRCEL-CELINE). The linked database contains information on all persons officially registered in the Brussels-Capital Region in 2001.

It consists of two parts. The first part, 'inequalities in outdoor air pollution', is mainly based on quantitative analyses, while the second part, 'policy', is based on a literature study and in-depth interviews with various experts on this theme.

### OUTDOOR AIR POLLUTION IS AN URGENT PROBLEM

Given the increased scientific knowledge about the impact of outdoor air pollution and the still relatively poor air quality in large parts of the Brussels Region, improving air quality is a matter of urgency. The urgency lies in the impact of outdoor air pollution on the health and well-being of everyone exposed to it and in its lifelong consequences for young and unborn children.

There is indeed solid evidence of a link between elevated concentrations of outdoor air pollution and mortality risk<sup>[1]</sup>. Studies investigating the effect of outdoor air pollution on cardiovascular and respiratory diseases suggest an increased risk of ischaemic heart disease, strokes, infections of the lower respiratory tract, asthma or chronic obstructive pulmonary disease<sup>[2][3]</sup>. There is also growing evidence for a link to poorer mental health such as psychological stress, symptoms of depression or suicide<sup>[4][5]</sup>. Furthermore, brain damage caused by outdoor air pollution seems to result in dementia; several studies have also shown a link with weakened cognitive functioning throughout the course of life<sup>[6][7]</sup>. In addition, exposure to air pollutants could have potentially harmful effects from the earliest stages of life. This would not only have negative effects on pregnancies, but also long-term effects that affect susceptibility to disease later in life<sup>[8]</sup>.

In addition to a significant direct health cost, outdoor air pollution also indirectly creates numerous social and economic costs through, among other things, the loss of healthy life years, medical costs and reduced productivity.

These direct and indirect costs associated with outdoor air pollution call for an urgent but also ambitious policy.

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### DISPARITIES IN OUTDOOR AIR POLLUTION

The following contains an overview of the inequalities in the field of outdoor air pollution. First, the unequal awareness of the health risks of outdoor air pollution, the limited problematisation of outdoor air pollution and the unequal negative impact of outdoor air pollution on the Brussels population are discussed.

#### Unequal knowledge about the consequences of outdoor air pollution

Although the problematisation of outdoor air pollution can count on growing social support, there is still considerable inequality within the Brussels population in terms of knowledge about the (negative) consequences of outdoor air pollution.

It is mainly the white and highly educated middle classes and people who are directly affected by the consequences of outdoor air pollution that are problematic and are actively calling for measures to promote air quality. Socially vulnerable groups, if they are at all aware of the impact of outdoor air pollution on health, often have more urgent and more tangible problems that limit an active problem of outdoor air pollution.

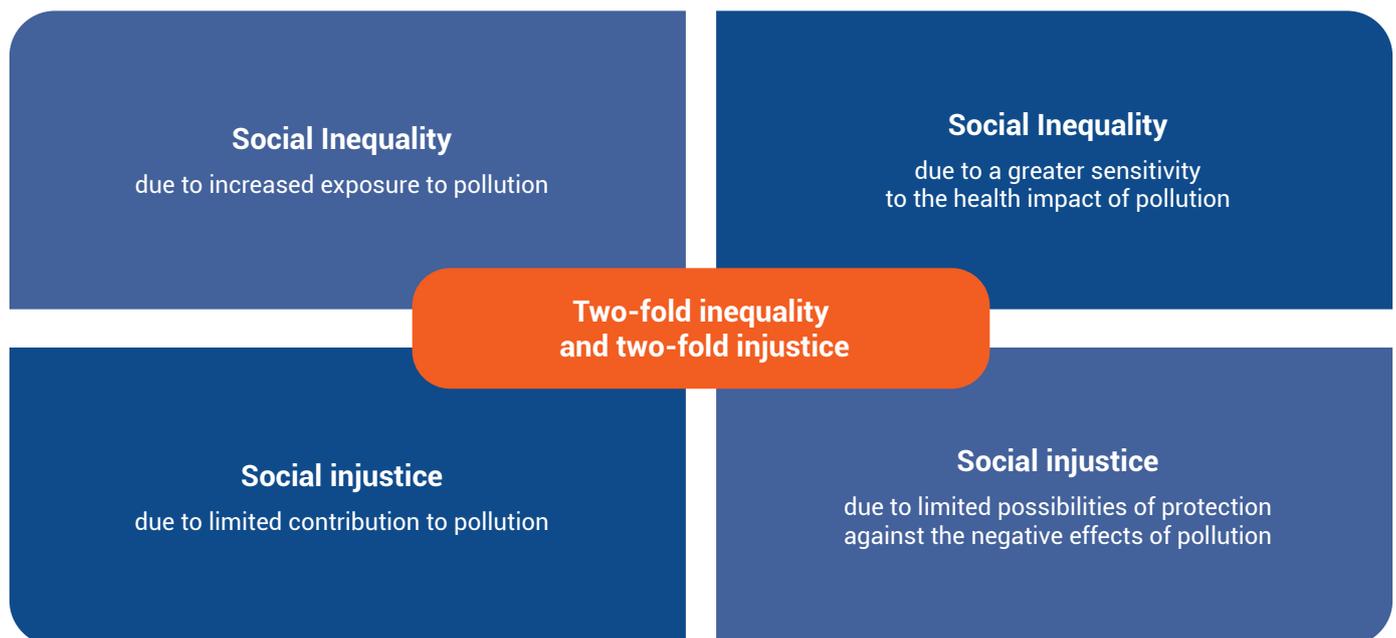
#### The negative effects of outdoor air pollution are unevenly distributed

Although they are less problematic in terms of outdoor air pollution, socially vulnerable groups are most affected. Moreover, they are most susceptible to its negative impact. Social inequalities around environmental health are exacerbated by several mechanisms. Socially vulnerable groups are victims of two-fold inequality and two-fold injustice<sup>1</sup>.

A first factor of inequality is the increased exposure to environmental elements with a negative impact on health.

In the Brussels-Capital Region, everyone is exposed to the main sources of external air pollution, both in the disadvantaged and in the better-off neighbourhoods of the region. In Brussels-City and in the first crown neighbourhoods<sup>1</sup>, that is the socially deprived neighbourhoods, there are more structural and infrastructural elements that increase exposure. There are more narrow streets that create street canyon effects<sup>2</sup> and there is also more motorised traffic in these neighbourhoods.

**Figure 1.** Two-fold inequality and two-fold injustice in environmental health in relation to socially vulnerable groups



<sup>1</sup> Refers to the neighbourhoods between the avenues of the inner ring and the middle ring, formed by the Churchill Avenue (to the south), the military avenues (to the east: General Jacques, General Meiser, Brand Whitlock, August Reyers, General Wahis) and the railway lines (to the west). From a municipal point of view, these are usually associated with Anderlecht, Etterbeek, Ixelles, Koekelberg, Molenbeek-Saint-Jean, Schaerbeek, Saint-Gilles and Saint-Josse-ten-Noode. Because of its spatial extent, Brussels-City is considered on its own. <https://wijkmonitoring.brussels/glossarium/>

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The distribution of the concentration of outdoor air pollution and income deprivation is illustrated in Figures 1 and 2. Higher concentrations of  $PM_{2.5}$  are observed along the network of regional roads, particularly around the first crown and slightly skewed towards the north-west axis. The majority of the areas exposed to higher concentrations of  $PM_{2.5}$  overlap the areas characterised by a higher degree of income deprivation, measured by the percentage of very low comfort<sup>3</sup> houses according to the 2001 Belgian census data.

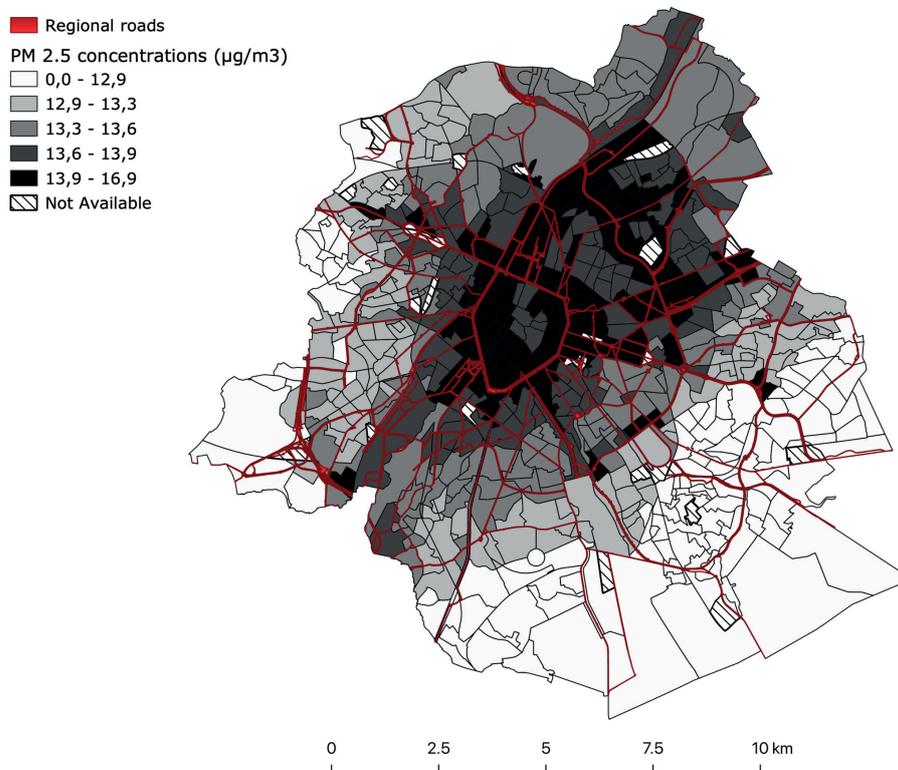
Other elements contributing to a higher exposure of socially vulnerable groups to outdoor air pollution are the living and working situation. The maps above clearly show that socially vulnerable groups tend to live in dwellings with low housing quality, characterised by poor ventilation and insulation. In addition, they often work in jobs carried out in public spaces (bus drivers, street sweepers, ...) which encourages a higher bare count of outdoor air pollution.

A second inequality factor is the greater impact these negative environmental elements have on health. The unfavourable living conditions in which socially vulnerable groups live – poor housing, poor working conditions, financial stress, unhealthy food, ... – result in a greater negative impact of outdoor air pollution on their health.

Figure 4 shows age-standard mortality rates for natural causes of death by statistical sector in Brussels. The map shows a clear pattern with some strong concentrations in the centre of the ring and some in the west of Anderlecht.

*In Brussels-City and in the first crown neighbourhoods, that is the socially deprived neighbourhoods, there are more structural and infrastructural elements that increase exposure.*

**Figure 2.** Annual average concentrations ( $\mu\text{g}/\text{m}^3$ ) of particulate matter with an aerodynamic diameter of less than  $2.5\mu\text{m}$  ( $PM_{2.5}$ ). Average values by statistical sector. Brussels-Capital Region, 2005.



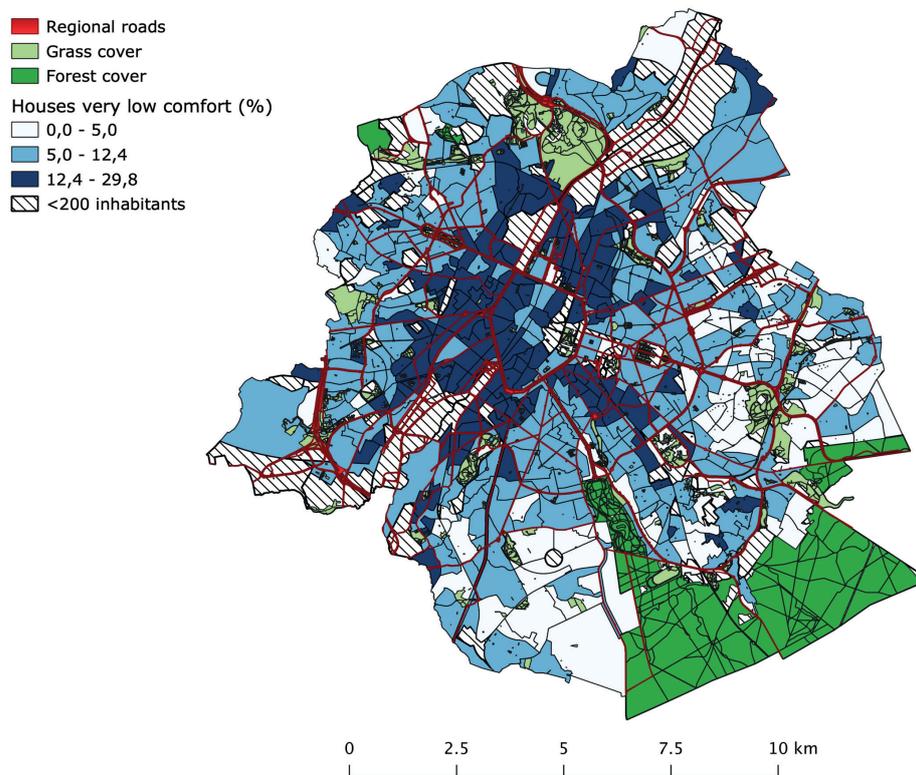
Sources: Brussels main through-roads, mobility;  $PM_{2.5}$  concentrations from 2005 data by IRCEL-CELINE.

<sup>2</sup> A street canyon (English: *street canyon* or *urban canyon*) is a location where a street is flanked on both sides by buildings, canyon-like forming an environment. These man-made canyons originate from streets with dense building structures, mostly Sky-scrapers. Street canyons can influence local conditions in the lower parts of the troposphere. This is called the street canyon effect. <https://nl.wikipedia.org/wiki/Straatcanyon>.

<sup>3</sup> Homes with very low comfort are homes that do not meet the minimum requirements (a WC or a bathroom with bath and/or shower).

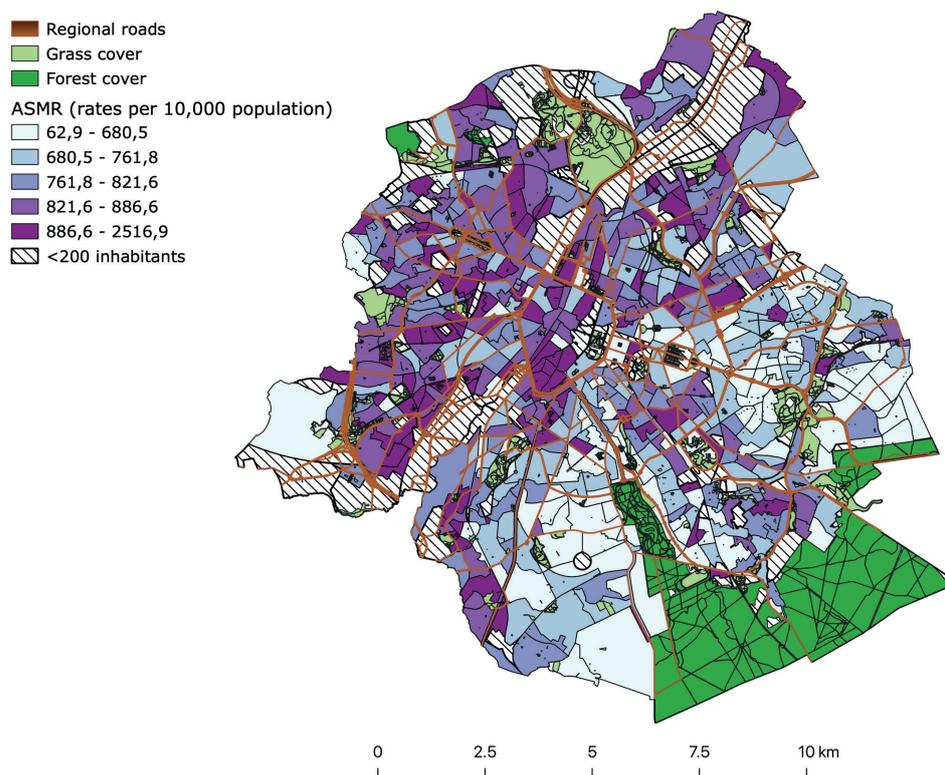
## ENVIRONMENTAL INJUSTICE IN OUTDOOR AIR POLLUTION

**Figure 3.** Percentage of very low comfort houses (without WC or bathroom) by statistical sector. Brussels-Capital Region, 2001.



Sources: Brussels regional roads.mobility; grass and forest cover of Urbis map; % houses with very low comfort of the Belgian census of 2001.

**Figure 4.** Age-standardised mortality rates for natural causes of death (per 10,000) by statistical sector, Brussels-Capital Region, 2001 - 2016.



Sources: Brussels-Region roads, mobility; grass and forest cover of Urbis map; age-standardised mortality rates (direct standardisation with as standard the total mortality due to natural causes of death in 2001-2016).

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An increase in particulate matter concentrations seems to have a significant impact on natural causes of death in the Brussels-Capital Region. Figure 5 clearly illustrates that the risk of dying from natural causes is 15% higher when  $PM_{2.5}$  concentrations increase by  $5\mu\text{g}/\text{m}^3$  and 16% higher when  $PM_{10}$  concentrations increase by  $10\mu\text{g}/\text{m}^3$ .

In addition, it is also clear that the excess mortality due to air pollution in deprived neighbourhoods is higher compared to the better-off neighbourhoods. An increase of  $10\mu\text{g}/\text{m}^3$  in the concentration of  $PM_{10}$ , for example, results in a 27% increase in the mortality rate in deprived neighbourhoods compared to 7% in the better-off neighbourhoods.

Higher exposures to air pollution and a greater sensitivity to its health impact among socially vulnerable groups testify to a twofold social inequality but also to a twofold social injustice because socially vulnerable groups would contribute less to air pollution and because their possibilities to protect themselves against air pollution are more limited.

Within the context of the Brussels-Capital Region, it is difficult to state unequivocally that socially vulnerable groups have a lower share in causing outdoor air pollution. However, this is true for air pollution caused by car use. It is mainly the cars of commuters and the higher socioeconomic classes that cause nitrogen dioxide and particulate matter. Another important source of outdoor air pollution is heating. Exact figures on this are lacking, but there are indications that vulnerable groups have less efficient

and less ecological heating. Socially vulnerable groups already have fewer financial resources, which makes it more difficult for them to switch to alternatives that reduce exposure to outdoor air pollution.

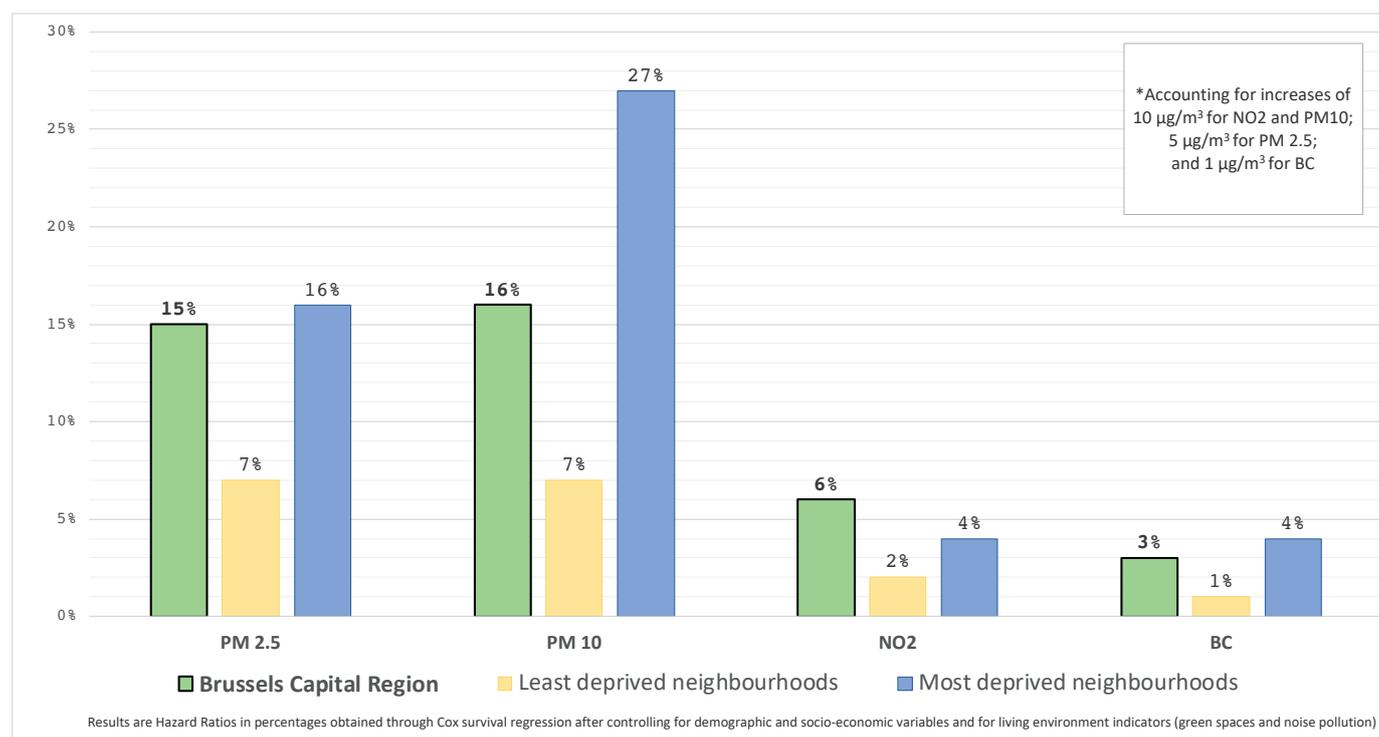
## POLICIES

The following provides an overview of current policy on outdoor air pollution and makes suggestions for future policy.

### Policy on external air pollution is mainly driven by the need to meet (international) standards.

There is an area of tension between the various policy perspectives in the field of outdoor air pollution. A first point of debate is the definition of a certain air quality as 'air pollution'. The issues of which air quality falls under the heading of air pollution and which does not, and which standards are used to draw the line between 'non-contaminated air' and 'polluted air' are under discussion. The standards that are binding for our country are prescribed by the European Union. These do not necessarily coincide with the standards of the World Health Organisation and

**Figure 5.** Change in relative mortality due to natural causes of death per increase\* in concentrations of outdoor air pollution



Source: Air pollution concentrations in 2005: IRCEL-CELINE; Green spaces: 2006 Urban Atlas (% total green in a buffer of 300 m from the residential address); Noise nuisance: 2016 Environment, Brussels (Nocturnal average noise levels in dB at the residential address); mortality and socio-economic and demographic indicators: National Mortality Database (N= 708.105 inhabitants in the Brussels-Capital Region) 2001-2016.

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are therefore often controversial. For example, the World Health Organisation's standard for particulate matter is much stricter than that of the European Union.

In terms of policy, there are therefore two perspectives on the basis of which outside air pollution can be defined: the health perspective and the legalistic perspective. The health perspective takes the health of the population as its starting point and strives for far-reaching measures that try to limit the negative health impact of air pollution as much as possible. This perspective is generally used by academics who study the theme of air pollution.

The legalist perspective motivates measures in relation to a legal framework based on internationally imposed standards, which seeks to model policy in such a way that the Region complies with these standards. There is a clear field of tension between the two perspectives and often the legalist perspective, which does not focus on maximum health gains, prevails. This obviously has implications for the ambitions of policy-makers and for the way in which air quality is measured and monitored. However, the costs of limited political ambition are very high. These concern not only possible fines for breaching the legally enforceable European limit values, but go a lot further when all direct and indirect health costs are taken into account. Politicians are still insufficiently aware of the total (medical) costs associated with air pollution.

If public health is the ultimate policy test, then a 'legalistic approach' to air pollution clearly falls short. From a health perspective, the policy strives for far-reaching measures motivated by the idea of limiting the health risks of outdoor air pollution as much as possible. On the one hand, this requires an approach that tackles the problem of outdoor air pollution at source and a more holistic and transversal policy flanked by actions that inform and raise awareness among the population about the health risks of outdoor air pollution.

When policy measures are formulated from a health perspective, it is important to include the aspect of health-related inequality. After all, there are two approaches from which policy measures to promote health can be formulated. On the one hand the "level approach" and on the other hand the "gap approach". The level approach starts from the idea of tackling average health problems whereas a "gap approach" focuses on inequalities in health<sup>14</sup>. Policies are ideally designed based on both perspectives and should therefore focus on improving the overall air quality within the Brussels-Capital Region on the one hand, but also give priority to socio-economic inequalities linked to the exposure and health of Brussels residents on the other.

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### Outdoor air pollution measures should focus even more on tackling pollution at source.

The arsenal of protective measures against the negative impact of outdoor air pollution, once the air pollution is a fact, is limited. This applies in particular to socially vulnerable groups, who have fewer resources to protect themselves. It is advisable for policy to focus even more on remedial measures aimed at the source of the pollution in order to contain the outside air pollution itself.

Although the sources of outdoor air pollution are diverse, most originate from road transport (for nitrogen dioxide) and the heating of buildings (for particulate matter). A remedial policy aims to reduce emissions within these sectors.

### Need for more co-operation between and within different policy levels

Because air quality is related to various policy areas and is a matter that is not limited to regional and/or national borders, there is a need for a more holistic and transversal policy and a policy that is conducted and made at local and regional level as well as at national and European level

First and foremost, co-operation between different levels of competence should be stepped up. Air quality is a regional competence. However, the framework policy is very fragmented. Health, for example, the most fragmented area of competence, is largely a federal competence, while health awareness is the competence of the Communities. Mobility is partly a regional and partly a federal competence (railways and commercial vehicles), energy is a regional competence, but the regulation of stoves, for example, is once again a federal competence. This makes combating outdoor pollution a very complex matter, which in any case calls for a global policy as the problems are not limited to regional borders. Concentrations of particulate matter measured on the territory of the Brussels-Capital Region are partly the result of pollution from other regions and even abroad. Pollution is also caused by commuters who come to work in the Brussels-Capital Region by car from other regions. Conversely, pollution from the Brussels-Capital Region also travels to the surrounding areas. Pollution reduction policies often conflict with the interests of the various levels of authority.

Secondly, there also needs to be more intensive co-operation between different areas of competence. However, given the urgency of the problem, there is a need for an effective policy supported by all competent policy levels, also outside the domain of environment, as the problem of outdoor air pollution is a problem that affects different policy areas such as the environment, taxation, mobility, spatial planning as well as poverty and social exclusion. In order for policies to be social, it is indeed important to include poverty and social policies in their design.

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### Policies should focus on better information and awareness-raising about the health risks of outdoor pollution.

The knowledge citizens have about the air quality surrounding them and the impact of this air quality on their health is very limited. In order to inform and sensitise people, there is a need for qualitative information, transparent and accurate communication that raises awareness at various levels.

Having relevant information at their disposal is indispensable for the regional authorities in order properly to inform citizens about air quality. It is therefore indispensable to carry out measurements of sufficient quality in representative places. In order better to map outdoor air pollution in the Brussels-Capital Region and to identify problematic sites and define tailor-made measures, finer measurements of air quality are necessary. In addition to having detailed measurement results, it is also of paramount importance to communicate these results in a timely, proactive and transparent manner. This would allow more preventive measures to be taken. Creating, implementing and enforcing measures is not in itself sufficient to structurally improve air quality. Policy should focus on better informing and

raising awareness about the health risks of outdoor air pollution. Measures achieve much greater support when they are framed and when people know 'why'. It is therefore important to link the theme of air quality and related themes such as mobility, taxation, etc. to the impact of outdoor air pollution on health. This awareness-raising is now mainly done by action groups, but should be much more government driven.

Awareness-raising should also take place at the political level, at the meso-level as well as at the individual level. At the moment, the government often focuses on (behavioural) changes of individuals, and not enough on higher policy levels. However, individual behaviour needs to be supported and/or steered by accompanying policy interventions at higher levels.

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## THE AUTHORS & THE PROJECT



**Charlotte Noël** obtained a Master's degree in Anthropology in 2010 and has since October 2017 been associated with the Interface Demography research group at the VUB where she works as a PhD candidate under the supervision of Prof. Dr. Sylvie Gadeyne (VUB). Her research focuses on the relationship between the environment and health in the region of the Brussels-Capital Region. More specifically, she examines how different social groups differ in their use, perceptions and beliefs about their living environment – and how this relates to 'objective' reality.

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**Lucía Rodríguez Loureiro** holds a Master's degree in Public Health from Pompeu Fabra University in Barcelona. She is currently working on her PhD at Interface Demography under the supervision of Prof. dr. Sylvie Gadeyne (VUB) and Dr. Lidia Casas (KU Leuven). Her research focuses on the quantitative analysis of the relationship between the residential environment and health and mortality within the Brussels-Capital Region.



**Sylvie Gadeyne** is, as sociologist/demographer, involved in several research projects, especially in the field of social inequality in health and mortality in Belgium and Europe. She started as a researcher at Interface Demography in 1999 where social differences in general and cause-specific mortality were for the first time studied in Belgium on the basis of individual data. These analyses resulted in a PhD in sociology in 2005. As a postdoctoral researcher at the FWO, she continued this research on the basis of more recent data for the 2000s. She also participated in several national and international projects on social differences in health in Europe. In addition to her research activities, she has been a lecturer at Ghent University (Research Methods), the Catholic University of Leuven (Population Sociology) and is now at the Vrije Universiteit Brussel (Statistics I, Research Methods, Social Demography, Social Epidemiology and European Social and Population Issues).



**Christophe Vanroelen** is senior lecturer in sociology and director of Interface Demography, a research group associated with the Department of Sociology of the Vrije Universiteit Brussel. He holds a doctorate in social health sciences and a master's degree in sociology and applied statistics for the social sciences. He has already been involved in several scientific research projects on socio-economic differences in health, social health determinants and work-related determinants in particular. His current research focuses primarily on the quality of work and the quality of living conditions in relation to the well-being and health of the population.



**Lidia Casas** is environmental epidemiologist with expertise in the health effects of indoor and outdoor air pollutants. In 2013, she obtained her PhD in Biomedicine about the effects of early life exposure to indoor microbial agents and cleaning products on child health. The work included in this thesis was performed at the former Centre for Research in Environmental Epidemiology (CREAL – now ISGlobal) in Barcelona, Spain. Since 2013, she is post-doctoral researcher at the Centre for Environment and Health (KU Leuven) where she conducts research on the health effects of green spaces, air pollution and several indoor exposures. Since 2019, she is also lecturer of epidemiology and environmental epidemiology at the University of Antwerpen.

Green&Quiet-project: <http://greenandquiet.be>

## ENVIRONMENTAL INJUSTICE IN OUTDOOR AIR POLLUTION

### PROJECT PARTNER

**KU LEUVEN**

Centre for Environment and Health

### GODFATHERS OF THE GREEN & QUIET PROJECT



BRAL, Citizens Action Brussels, is project's main partner in order to develop its expertise on air quality and health. And then raise awareness among the people of Brussels and the public authorities: [www.bral.brussels](http://www.bral.brussels)



Bruxelles Environnement:  
<https://leefmilieu.brussels>



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The external experts were consulted about a preliminary version of the policy recommendations. They did not co-author the policy recommendations and did not necessarily agree with its content. The policy recommendations are also under the full responsibility of Interface Demography. »