URBAN AGENDA FOR THE EU

WORKING TOGETHER FOR BETTER CITIES

AIR QUALITY

CODE OF GOOD PRACTICES FOR CITIES AIR QUALITY PLANS

Part III

Methodologies and Tools for Assessment

Comune di Milano

European Commission

AGENZIA MOBILITÀ AMBIENTE TERRITORIO

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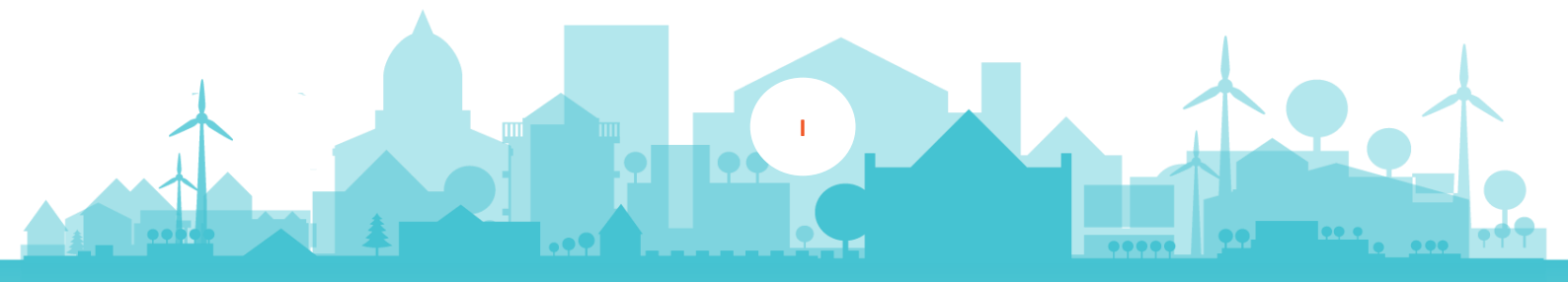

Partnership on Air Quality

The Urban Agenda for the EU - consolidated with the Pact of Amsterdam, agreed on 30 May 2016 by the EU Ministers responsible for Urban Matters - has introduced a new working method of thematic Partnerships being elaborated by partners representing various governance authorities aiming to tackle social challenges by focussing on cities. It aims to promote cooperation between Member States, Cities, the European Commission and other stakeholders, in order to stimulate growth, liveability and innovation in the cities of Europe. The Partnership on Air Quality is one of the 12 priority themes of the "Urban Agenda for the EU".

The main objective of the Partnership on Air Quality is to improve air quality in cities and to bring the 'healthy city' higher on the local, national and EU agendas as part of the Urban Agenda. This will be done through improving the development and/or implementation of regulation, funding mechanisms and knowledge at all levels, as well as the coordination between them.

The Partnership's actions and recommendations also aim to contribute to the goals of the New Urban Agenda and to the targets set in the Sustainable Development Goals.

The Partnership on Air Quality is composed by:

EU Member States:

- The Netherlands (*Coordinator*)
- Croatia
- Czech Republic
- Poland

Cities:

- Helsinki/HSY[1] (FI)
- London (UK)
- Utrecht (NL)
- Milan (IT)
- Constanta (RO)
- Duisburg (DE) - representing the Consortium Clean Air Ruhr Area

Stakeholders:

- EUROCITIES
- HEAL[2]

European Commission:

- DG Regional and Urban policy (*Coordinator*), DG Environment, DG Research & Innovation, DG Agriculture, DG Growth, the Joint Research Centre.

URBACT follows the work of the Partnership as an observer.

[1] Helsinki Region Environmental Services Authority.
[2] Health and Environment Alliance.

“As a society, we should not accept the cost of air pollution.

With bold decisions and smart investments in cleaner transport, energy and agriculture, we can both tackle pollution and improve our quality of life.

It is encouraging to see that many European governments and specifically cities are showing leadership in protecting people's health by improving air quality.

Clean air belongs to everyone, including people living in cities.”

Hans Bruyninckx
Executive Director of European Environment Agency

Preface

Air pollution is one of the main environmental concerns in Europe, especially in urban areas where three quarters of Europeans live. Poor air quality in cities is associated with significant health effects which lead to huge societal and economic costs. Finding solutions to improve air quality is one of the greatest challenges for Europe.

This Code of Good Practice provides guidelines for cities for drafting and implementing of Air Quality Plans, prescriptive instruments introduced by the Ambient Air Quality Directive 2008/50/EC in order to achieve EU standards. The Code includes a presentation of other tools developed by the Partnership on Air Quality to realize the 'Healthy city'. The Code is one of the results of the actions undertaken by the Partnership on Air Quality under the umbrella of the European Urban Agenda.

Cities are places where exposure to air pollution exposure higher. They also remain the immediate level of intervention for dealing with threats to human health coming from pollutants such as nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and ground-level Ozone (O_3).

EU legislation introduced Air Quality Plans as compulsory for zones or agglomerations within which concentrations of pollutants in ambient air exceed Limit or Target values for protection of human health. The purpose of Air Quality Plans is to set effective measures for attaining Limit or Target Values while keeping the period of exceedance 'as short as possible'. The implementation of an Air Quality Plan can also bring other additional benefits for the quality of life in urban areas, contributing to attain the Sustainable Development Goals of the United Nations for the 2030 Agenda.

This Code is not intended to be a fully exhaustive handbook for drafting an Air Quality Plan. Nevertheless, the Partnership believes that it can be very helpful for cities that are designing and implementing air quality plans, and that it can even inspire cities that want to manage air quality issues and at the same time generate multiple benefits for their inhabitants, for the ecosystem and for the economy. This Code has also been designed to support local decision-making, by improving understanding in Air Quality plans, by showing tested ways to comply with applicable EU legislation, and by helping cities bringing down concentrations of air pollutants and thus improve public health.

The measures defined by an Air Quality Plan to reduce air pollution should address different sectors, whose enforcement and implementation are of respective competence of urban, regional, national or EU authorities, thus co-operation between different levels of governance and integration of planning undertaken at different level or in different sectors is a key factor for improving air quality in cities.

René Korenromp
Coordinator of the Partnership on Air Quality
The Netherlands, Ministry of Infrastructure and the Environment

Executive summary

The **Air Quality Plan is a strategic planning instrument** introduced by the Ambient Air Quality Directive 2008/50/EC (AAQD). The drafting on an **Air Quality Plan (AQP) is compulsory for any '*zone*' or '*agglomeration*' within which the concentrations of pollutants in ambient air 'exceed any Limit value or Target value'** designed for the protection of human health. The AAQD legislation requires that an Air Quality Plan **sets out appropriate, cost-effective measures to achieve compliance with air quality Limit or Target values** while keeping the period of exceedance '*as short as possible*'.

The adoption of an Air Quality Plan has some direct environmental and societal benefits such as the **improvement of the health of residents and city users** - with reduction of the associated economic impact - and positive feedback for climate change effects mitigation. The implementation of an Air Quality Plan can have also other **additional benefits for quality of life in cities**, contributing to reach many of the United Nations Sustainable Development Goals for the 2030 Agenda.

It is not easy to find guidelines on how to draft and implement AQP at local level that could be used by cities of different EU Member States, due to different approaches adopted at national level for implementing Dir. 2008/50/EC. Existing guidelines are not recent or mainly focus on tools for the elaboration of a plan, rather than on the legal and management processes that have to be followed for its preparation, adoption and implementation. This is the reason for drafting this Code, which is specifically designed to help cities and local authorities in charge of planning Air Quality plans comply with EU legislation and better protect the health of citizens and the environment.

The **mandatory pieces of information that must be included in an AQP** are listed in Section A of Annex XV of the AAQD (see *Section 4.1 - Mandatory Elements* and *Appendix I* of the Code). These include an analysis of the situation based on monitored AQ data and related maps of non-attainment areas, on the use of modelling tools for the assessment of pollution sources (emission inventory, source apportionment, pollutant dispersion models, etc.) and on the relative effectiveness of possible measures in achieving compliance with AQ Limit or Target values. Details of abatement measures and any associated projects adopted with a view to reducing pollution should each be listed and described in an AQP with an accompanying timetable for implementation, as well as the authority responsible for it and the related follow-up (or monitoring of the plan).

By means of Cities AQPs local administration could add to the overarching (regional and national) Air Quality planning instruments important local specific measures, that

cannot be managed at higher level of governance, counting on its peculiar tasks and powers. In the meantime, a number of measures defined as 'necessary to reach the targets' during the elaboration of a city AQP cannot be solved solely at an urban level and should address different sectors whose enforcement and implementation could be of competence of overarching authorities, such as Metropolitan area or Agglomeration, Regions, Members States or EU institutions. Thus, **co-operation between different level of governance and integration of planning regarding different sectors is a key factor** for a real improvement of cities air quality (see *Section 4.3 - Integration with other Plans and Programmes*).

Starting from April 2019 local authorities should consider the National Air Pollution Control Plan (NAPCP) compulsorily published by Member States as part of the Dir. 2016/2284/EU, the so-called National Emission Ceiling Directive (NECD). Since each Member State should draw up, adopt and implement a NAPCP with a view to complying with its emission reduction commitments, and to contributing effectively to the achievement of the air quality objectives, it is expected that adopted **NAPCP should contribute to the successful implementation of Air Quality Plans** established under Article 23 of Directive 2008/50/EC.

In accordance with the AAQD (art. 26) and the *Directive 2003/35/EC (*Public Participation Directive - PPD) **the process of drafting an AQP must be open to public participation at all stages of development** (see *Section 6.2 - Participatory approach*). To prepare this public dialogue, to improve acceptability of the proposed measures and to increase efficacy on their implementation, a good practice for cities administration, starting since the first steps of the AQP process, would be to **raise citizens awareness on AQ issues** through transparent and more accessible information on AQ monitored data, health effects related to poor air quality and disseminate good practices in transport, energy and other related sectors to reduce citizens responsibility in emission production (see *Section 6.1 - Citizens Awareness*).

The AAQD and Decision 2011/850/EU (so-called 'IPR Directive') state that once an AQP has been initiated, the relevant level of governance is required to compile, *with the help of the IPR Guidelines,* the mandatory elements with a specific procedure that automatically process data by an electronic tool, part of the *EU's* ***e-Reporting system*** *(see Section 4.5 - E-reporting format and Requirements).*

The follow-up of the AQP is performed by regular updating of the indicators set during the elaboration on the plan that would show the degree of the measures' implementation and their real impact on air quality levels.

The European Commission (EC) monitors the implementation of EU legislation in Member States to ensure that laws achieve their intended objectives and that all

countries of the EU respect the rules that have been agreed. In this context the EC through the e-reporting system controls the correct drafting and implementation of Air quality Plans in EU. Once an AQP is produced it must be communicated to the Commission within two years from the end of the calendar year in which the first exceedance was observed. If an AQP is not delivered to the legislated requirements under the relevant Directives, then **infringement procedures may be opened against a Member State**.

The Partnership observed that dynamics of measures implementation of an Air Quality Plan are to a high degree influenced by the business plans of each individual competent authority, primarily their organizational capacities and the availability of necessary financial resources. Several EU and national funds are available to prepare and implement national, regional and local air quality policies. However, an overall lack of specific programmes dedicated to funding of projects aimed at air pollution reduction has been observed and access to procedures to acquire funding for clean air projects from EU funds is considered difficult by many local authorities. Thus, the Partnership found necessary to explore ways to assess funding needs for the sustainable design/implementation of Cities Air Quality Plans, to design an appropriate **business model to fund air quality measures** and a **Guidance for cities looking for funding AQPs** that have been developed in co-operation with the European Investment Bank (See *Section 6.3 Funding opportunities*).

This Code is not intended to be a fully exhaustive guidance for the preparation and implementation of a AQP, but would be of help in the practical work and could be a source of inspiration for cities that want to manage air quality issues. This is done, starting from legislation and state of the art and presenting a list of **good practices in drafting Air Quality Plan in full compliance with Directive 2008/50/EC provisions** (*Appendix IV)* and **examples of Air Quality measures** recently planned or successfully adopted on in EU cities (*Appendix V*).

A short **list of recommendations** from the Partnership on Air Quality closes the document.

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Abbreviations and Acronyms

APHEKOM	Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe project
AQP	Air Quality Plan
AQPs	Air Quality Plans
B(a)P	Benzo(a)pyrene
BC	Black Carbon
CHD	Coronary Heart Disease
CLRTAP	UNECE Convention on Long Range Transboundary Air Pollution
CO_2	Carbon Dioxide
COPD	Chronic Obstructive Pulmonary Disease
CRF	Concentration-Response Function
CVD	Cardiovascular disease
DALY	Disability-Adjusted Life Year; metric for indicating burden of disease based on the combination of years of life lost YLL and years lost due to disability YLD
DPF	Diesel Particulate Filter
DPSIR	Driving forces, Pressure, State, Impact, Response: causal framework for describing the interactions between society and environment, adopted by the EEA
EC	Elemental Carbon
EEA	European Environmental Agency
EEV	Enhanced Environmentally-friendly Vehicles
EU	European Union
FAIRMODE	Forum for AIR quality MODElling in Europe
GDP	Gross Domestic Product
HIA	Health Impact Assessment
COPERT	COmputer Programme to calculate Emissions from Road Transport
HBEFA	HandBook Emission FActors for road transport
HRAPIE	Health Risks of Air Pollution In Europe project
LEZ	Low Emission Zone
LTZ	Limited Traffic Zone
NAPCP	National Air Pollution Control Programme
NNRM	Non-Road Mobile Machinery
NO_2	Nitrogen Dioxide
O_3	Ozone
PAQ	Partnership for Air Quality
PM	Particulate Matter
PM_{10}	Particulate Matter with an aerodynamic diameter smaller than 10 µm

$PM_{2.5}$	Particulate Matter with an aerodynamic diameter smaller than 2.5 µm
REVIHAAP	Review of Evidence on Health Aspects of Air Pollution project
RR	Relative Risk; describes the likelihood of adverse health effects occurring in high exposed populations compared to low exposed populations
SEA	Sustainable Energy Action Plan
SHERPA	Screening for High Emission Reduction Potential on Air project
SUMP	Sustainable Urban Mobility Plan
UNECE	United Nation Economic Commission for Europe
WHO	World Health Organization
YLD	Years Lost due to Disability, a component of DALYs
YLL	Years of Life Lost, a component of DALYs
µg/m^3	Microgram(s) per cubic meter

1 INTRODUCTION

The work of the Partnership on Air Quality has allowed identifying issues of concern for many cities relating to the development and implementation of their Air Quality Plans (AQPs). Notably, it has been found that:

- ✓ access to knowledge and experiences on processes of preparing AQP (e.g. pitfalls, stakeholder interactions, governance, evaluation, etc.) from front-runner cities having already designed and implemented AQPs is often crucial to avoid inefficiencies, and that such knowledge should be improved.

- ✓ Knowledge of best practices in the selection, design, funding, and implementation of air quality measures is essential to facilitate the choice of the relatively most effective measures for the AQP, and that such knowledge should be improved.

An analysis of existing guidelines for drafting and implementing AQPs performed by the Partnership (see *Annex II* and *Annex III*) showed that there is a need for an EU-wide valid document, updated with most recent directives to guide municipalities in the process of adopting an AQP.
The Partnership identified the following actions to tackle the problem described above:

- ✓ development of a Code of Good Practice for Cities Air Quality Plans aiming to present good examples of some cities interpretation of the content listed under Annex XV, Section A of Directive 2008/50/EC.

- ✓ Assemble and keep updated the JRC register of best practices in urban air quality planning, in order to encourage the dissemination of knowledge on relevant air quality measures and facilitate comparative analysis on their relative effectiveness.

The Code of Good Practice for Cities Air Quality Plans, is one of the main products of the Action 2 - Better Air Quality Planning (Governance) included in the Action Plan of the Partnership on Air Quality, together with the updating of the Catalogue of Air Quality Measures managed by the JRC[3].

This Code of Good Practice was developed with the co-operation of the Members of the Partnership Air Quality, joining forces, competences and experiences. It is the result of a work that lasted more than a year, started with the collection of Air Quality Plans, dedicated questionnaires, and followed by technical meetings and public stakeholder engagement events.

[3] http://fairmode.jrc.ec.europa.eu/measure-catalogue.

2 INSTRUCTION FOR USE

The Code of Good Practice for Cities Air Quality Plans is organized in the way described in the followings.

Motivations to draft and implementing a City's AQP are listed in Section 3 - **Why to develop a City Air Quality Plan**, starting from compliance to EU legislation up to the contribution in reaching some United Nations Sustainable Development Goals for the 2030 Agenda.

Section 4 presents the **Content of the City Air quality Plan** starting from mandatory elements listed in Section A of Annex XV of the Ambient Air Quality Directive and considering all factors that could influence the organization of the content.

The Section 5 - **How to develop a City Air Quality Plan** contains schemes and suggestions to organize the process of drafting and implementing a City Air Quality Plan, together with a list of successful factors for the related governance.

In Section 6 - **How to manage and implement a City Air Quality Plan** are reported the key elements that need to be considered to obtain a smart process, required both by legislation and by pragmatism, based on hands-on experience.

Section 7 - **Methodology and tools for elaborating an City Air Quality Plan** contains state-of-the-art methodologies to perform the assessments needed for developing the strategy of the Air quality Plan together with practical examples selected by collected and analysed EU Cities Air quality Plans.

Each topic starts with references to the **legislation,** with citation of the related articles of directives and the description of required elements and tasks.

The Code presents **'state-of-the-art' methodologies and practices** developed in existing AQPs that present different levels of commitment (human resources, budget, computing capability, etc.).

In special boxes are presented some **examples of good practices** adopted by cities or Member States **for each topic** dealt in Sections.

In the Appendixes, apart from lists of existent guidelines for AQ planning and related tools and measures (*Appendix II and Appendix III*) some **examples** of **AQPs in full compliance with Directive 2008/50/EC** (*Appendix IV*), and **examples** of **Air Quality Measures successfully adopted** (*Appendix V*) are presented.

Close the Code of Good Practice for Cities Air Quality Plans **recommendations** from the Partnership on Air Quality about air quality planning: Good Policies, Good Governance and Good Practice (*Appendix VI*).

3 WHY TO DEVELOP A CITY AIR QUALITY PLAN

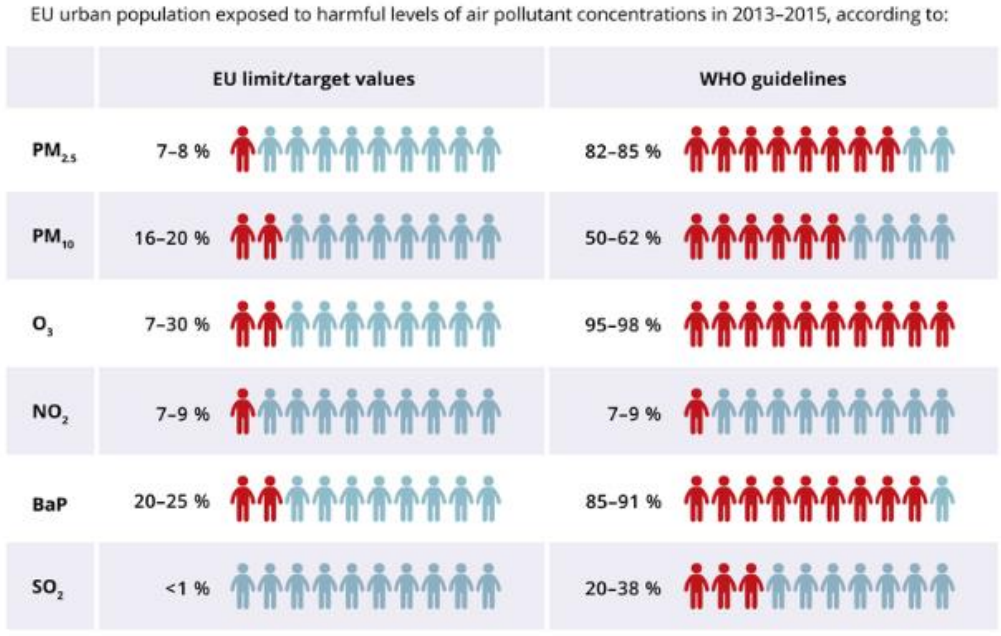
Air quality is one of the most important environmental issue in EU, being long-term exposure to $PM_{2.5}$ responsible for about 428 000 premature deaths in 2014; NO_2 and O_3 are responsible respectively for 78 000 and 14 400 premature deaths in the same year (EEA, 2017a). Reduction of life expectancy, chronic diseases, hospital admissions, medical expenses and working days lost mean a huge societal impact and an economic cost assessed around 5% of GDP for EU (World Bank-IHME, 2016).

Impact on human health is higher in cities, where hundreds of thousands to several millions people live and are exposed in direct proximity to toxic pollutants emitted by vehicular traffic, residential heating systems and power facilities, shipping activities, construction sites, solvent use, etc.

Exposure of such kind of pollutant activities refers both to residential population and daily 'city users', enlarging the wideness of the problem in term of health-related burden of air pollution that is significant for both short-term and long-term exposure.

As Figure 1 shows, the percentage of the urban population in the EU-28 exposed to air pollutant concentrations above certain EU and WHO reference concentrations is still too high, and it is clear that a lot of work has to be done to reduce pollution in urban areas and reach the 'Healthy City'.

Figure 1 - Percentage of the urban population in the EU-28 exposed to air pollutant concentrations above certain EU and WHO reference concentrations, in 2013-2015 period



Source: EEA, 2018; EEA, 2017a

Cities constitute the immediate administrative level to implement specific actions to reduce polluting activities and improve local air quality. Mayors are the public authority responsible for health of citizens: these two elements bring to the conclusion that air quality governance at urban level can be a challenge that must be tackled to gain overall public health benefits.

On the other hand, not all the problems related to a city's air quality can be solved at local level. It is therefore important to manage policies with an integrated approach that brings cities to work together with the higher level of governance (National Government, Regions, Metropolitan Authorities) or to lobby at international level if needed (e.g. to fight transboundary pollution).

3.1 Compliance with EU Legislation

Directive 2008/50/EC *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD*): Art. 2, art. 23, art. 24, art. 25, Annexes VII, XI, XII, XIV, XV*

Commission Directive (EU) 2015/1480 *of 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality*

Commission Implementing Decision 2011/850/EU *of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C (2011) 9068)* ('IPR Decision')

Directive 2004/107/EC *of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air* ('Fourth Daughter Directive')

Directive (EU) 2016/2284 *of 14 December 2016 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC* ('National Emissions Ceilings Directive' - NECD)

Directive 2003/35/EC *of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC* ('Public Participation Directive' - PPD)

The Air Quality Plan (AQP) is a strategic planning instrument introduced in the Ambient Air Quality Directive 2008/50/EC (AAQD). The drafting of an AQP is compulsory for any

'*zone*' or '*agglomeration*' within which the concentrations of pollutants in ambient air '*exceed any Limit value or Target value*' designed for the protection of human health. These values are specified in Annexes VII, XI of the Ambient Air Quality Directive.
The AAQD legislation requires an AQP to set out appropriate, cost-effective measures to achieve compliance with air quality limit or target values while keeping the period of exceedance '*as short as possible*'.

The mandatory elements that must be included in an AQP can be found in *Section 4.1 - Mandatory Elements.* These include a description of measures, assessment on the impact of measures, as well as the authority responsible for monitoring the measures. An AQP may additionally include measures aimed at protecting sensitive population groups, including children.

In situations where a zone or agglomeration is experiencing exceedances of more than one pollutant, the legislation suggests that a single '*Integrated'* AQP is produced. An integrated plan can help properly account for co-benefits of emissions reduction measures as well as help reduce the burden of drafting and implementing different plans. AQPs may include short-term measures, designed to mitigate the effects of current or predicted exceedances of one or more Alert thresholds (specified in Annex XII and related to NO_2, SO_2 and O_3) or one or more Limit values or Target values (specified in Annexes VII, XI and XIV and related to O_3 and $PM_{2.5}$). In the case of a predicted or current exceedance of an Alert threshold, a Member State '*shall*' draft a **Short-term Action Plan**, indicating the effective measures to be taken to reduce the risk or duration of such an exceedance[4]. In the case of a current or predicted exceedance of a Limit or Target value a Member State '*may*' draft a Short-term Action Plan. The measures in a Short-term Action Plan should aim to address high pollution episodes that last days or weeks and can include the control or suspension of activities contributing to the exceedance. These measures can include suspension of specific industrial processes or motor-vehicle traffic.

Each Member State is responsible for achieving and maintaining air quality target and limit values, and consequently for drafting and implementing AQPs as necessary. A Member State may devolve some or all these responsibilities to regional or local authorities, while all public bodies, including local and regional authorities, are required to work to achieve EU air quality target or limit values and cooperate with overarching authorities in implementing identified mitigation measures.

The AAQD refers to AQPs as covering zones and agglomerations:

- ✓ '*Zones and agglomerations*' are defined by each Member State for the purposes of air quality assessment and management;
- ✓ an '*agglomeration'* corresponds to a special type of zone that exceeds 250,000 inhabitants, or with a given population density per km² which for the Member States '*justifies the need for ambient air quality to be assessed and managed'*[5].

[4] However, Dir. 2008/50/EC in Art. 24 specifies that, where there is a risk that the Alert Threshold for Ozone specified in Section B of Annex XII will be exceeded, Member States shall only draw up such Short-Term Action Plans when in their opinion there is a significant potential, taking into account national geographical, meteorological and economic conditions, to reduce the risk, duration or severity of such an exceedance.
[5] Directive 2008/50/EC: Article 2 (17).

Given these criteria, larger cities are often represented as a single zone or agglomeration responsible for managing air quality, including the drafting of AQPs. In cases where transboundary sources are a significant contributor to exceedances, the Member States concerned shall cooperate in enacting measures to eliminate the exceedances. This can include joint activities including the drafting of a joint or coordinated AQP.

In the preparation of AQPs, local authorities should consider the National Air Pollution Control Plan (NAPCP) compulsorily published by Member States as part of the National Emission Ceiling Directive (NECD) from April 2019. The NAPCP may contain information that should be considered when drafting AQPs or contain actions that require local implementation. On the other hand NAPCPs would include information related to AQPs, such as their effectiveness in local compliance for Limit and Target values. More details on NAPCPs for the NEC Directive and vertical policy integration can be found in *Section. 4.3 - Integration with other Air Quality Plans and Programmes*.

In accordance with the AAQD (art. 26) and the Directive 2003/35/EC (Public Participation Directive - PPD) the process of drafting an AQP must be open to public participation at all stages of development, as described in *Section 6.2 - Participatory approach*.

Once an AQP is produced, it must be communicated to the Commission within two years from the end of the calendar year in which the first exceedance was observed. If an AQP is not delivered to the legislated requirements under the relevant Directives, then infringement proceedings may be brought against a Member State. Follow-up and reporting requirements are covered in more detail in *Section 6.4 - Monitoring, reporting and Reviewing* and in *Section 4.5 - E-Reporting format and requirement*. AQPs are classed as public documents and should be made publicly available, free of charge, by means of any easily accessible media, including the internet.

Box 1 - Standard format of an infringement proceeding text for Article 23 of Directive 2008/50/EC

Infringement Proceedings - *Member State*

Infringements of Article 23 of Directive 2008/50/EC have been taken up by the Court of Justice of the European Union (CJEU).

- ✓ On xx/xx/xxxx the CJEU found the *Member State* government[6] to be in breach of having systematically and continuously exceeded PM_{10} limit values throughout its territory and for having failed to prepare air quality plans, which would keep the duration of the breach as short as possible (Case X-XXX/XX) [7]
- ✓ XXXXX failed to fulfil its obligations under Article 23(1) to keep the duration of the breach "as short as possible" from xx/xx/xxxx until xxxx, by adopting appropriate measures in an air quality plan. Failure to comply with this judgment and, therefore, to improve the existing, inadequate, air quality plans would expose *Member State* to the payment of fines.

[6] https://eur-lex.europa.eu/
[7] http://curia.europa.eu/juris/recherche.jsf?language=en

3.2 Health Protection and other purposes

The main purpose of an AQP is the legal compliance with the achievement and/or the maintenance of EU Air Quality Limit Values or Target values settled by the Directive 2008/50/EC (Annex XI and XIV).

As in the current practice AQPs can also be developed to pursuit the following purposes that if declared could increase the public acceptance of the AQP:

- ✓ **Improvement of the health of residents and city users** due to reduction of air pollution exposure with benefit both for short-term and long-term related effects (increase of life expectancy, reduction for cancer risk, less cardiovascular and respiratory illness such as asthma, less neurological disorders and metabolic disorders such as diabetes, etc.) with special focus on sensitive people (children, young, elders, chronic patients, woman in pregnancy, etc.);

- ✓ **Reduction of the economic impact associated with burden of diseases and healthcare cost** related to health effects of air pollution exposure (chronic and short-term diseases, hospital admissions, loss of work days, …);

- ✓ **Improvement of the quality of life** related to improvement of health condition and to liveability of the city (e.g. less congestion in streets can bring more 'liveable' areas for pedestrian with higher safety levels and less noise, …);

- ✓ **Reduce social inequalities in term of health and quality of life** linked to local air pollution;

- ✓ **Integrate Air Quality into the decision-making process for other municipal sectorial plans and strategies** keeping air quality high on the agenda.

3.3 Related additional benefits

In addition to the objects listed in the previous Sections the adoption of a City Air Quality Plan can bring additional **health, social, environmental and economic benefits** that can summarized as in the followings:

1. Improve **health** of citizens in an indirect way, through measure adopted (e.g. health benefits due to promotion of active commuting[8] and reduction of traffic fluxes through discouraging private transport)
2. Most part of intervention to improve air quality could have positive feedback for **climate change** effects mitigation. In fact, in general the reduction of combustion activities, needed to reduce air pollutants, brings contemporarily the decrease of CO_2 emission, first product of fossil fuel combustion. Attention

[8] Cycling and walking.

must be taken for the opposite: climate change mitigation actions not always bring positive effects on air quality [9]

3. Reduction of vehicle traffic on streets could let to reduction on **noise** and related health issues;
4. Saving money when damage and soiling of buildings and **cultural heritage** is decreased;
5. Less damage and loss of **vegetation** patrimony of the city, due to demonstrated effects of critical level of O_3, NO_x and SO_2;
6. Saving money and economic profits for **agricultural production preservation**, for les damage to crops (see previous point);
7. Less pollution in **water** due to less leaching into aquifers and basins;
8. More **biodiversity** in the urban environment**;**
9. Improve the **public image /common perception** of the city;
10. Increase the **economic attractiveness and the competition capability** of the city, bringing more international investors, companies, employers and tourists.
11. **Increase the competition capability** of the city in application process for EU funding opportunity.

The adoption of an Air Quality Plan through the implementation of its measures contribute to reach many of the 17 Sustainable Development Goals settled by United Nations for the 2030 Agenda[10] (Figure 2 and Figure 3)

Figure 2 - United Nations Sustainable Development Goals for the 2030 Agenda

Source: https://www.un.org/sustainabledevelopment/sustainable-development-goals/

[9] See also *Section 5.5.3 - Climate Change Impact*.

[10] United Nations, 2015 - '*Transforming our world: the 2030 Agenda for Sustainable Development*', Resolution 70/1 adopted by the General Assembly on 25 September 2015, 21 October 2015

Figure 3 - Air Pollution in relation to the UN Sustainable Development Goals

Source: In EEA, 2017, adapted from UNICEF 2016

4 WHAT CONTENT FOR A CITY AIR QUALITY PLAN

4.1 Mandatory Elements

Directive 2008/50/EC *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD)*: Art. 23; Section A of Annex XV*

Commission Directive (EU) 2015/1480 *of 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality*

Directive (EU) 2016/2284 *of 14 December 2016 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC ('*National Emissions Ceilings Directive' - NECD*)*

Commission Decision of 19 March 2004 *concerning guidance for implementation of Directive 2002/3/EC of the European Parliament and of the Council relating to ozone in ambient air (notified under document number C(2004) 764)*

According to the Ambient Air Quality Directive - AAQD (Dir. 2008/50/EC) an Air Quality Plan (AQP) is a planning instrument settling 'appropriate' measures in order to attain the Limit values or Target values set out in the Directive.

AQPs have to comply with certain obligations, as far as a list of specific content: AQPs shall incorporate at least the information listed in Section A of Annex XV of the AAQD (see *Appendix III* of this Code).

A detailed guide covering the mandatory elements for AQPs is presented in the Commission's Decision 2011/850/EU (IPR Guidelines) [11].

The information to be included in the AQPs, in compliance to the cited Directives are described in the following:

- ✓ The **localisation of excess pollution** should be described within a region or city with a map and geographical coordinates of the measuring station(s) reporting the exceedance(s). Measuring stations should have a unique unambiguous code that has been generated by the Member State and used for the reporting.

[11] http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf and http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance2.pdf

- ✓ **General information** about the environment in which the exceedance has occurred is required, such as whether the zone is in a city, rural or industrial area including an estimation of the polluted area (km^2), or km of road, and of the population exposed to the pollution. This helps to assess the scale of any possible effects on public health, especially in densely populated urban environments and among the most susceptible and vulnerable groups. The classification of an urban area describes the location with respect to distribution and density of building and should distinguish it from suburban and rural areas. Urban areas are continuously built-up, meaning complete (or at least highly predominant) building-up of the street front side by buildings with at least two floors or large detached buildings with at least two floors[12] (IPR Guidelines). It is also necessary to provide useful climatic data and relevant data on topography with sufficient information on the type of targets requiring protection in the zone.

- ✓ **Responsible authorities**, the names and addresses of persons responsible for the development and implementation of air quality improvement plans are required. Competent authorities in an urban environment might conduct the AQP(s) themselves or contract third party organisations to fulfil some or all of the requirements in the AQP.

- ✓ The **nature and assessment of the pollution** should include concentrations observed over previous years and concentrations measured since the beginning of any associated air quality improvement measures (see *Section 7.1.1 - Air Quality Assessment*)

- ✓ The **origin of the pollution** should be identified with a list of the main emission sources responsible and a corresponding map of the area, contributions lower than 3% are not considered significant[13]. The total quantity of emissions from these sources (tonnes/year) should be presented together with information on pollution imported from other regions. Main emission sources have to be categorized in coherence with the classification required by the e-reporting system (see *Section 6.4* and *Section 4.5*)

- ✓ **Analysis of the situation** should detail the factors responsible for the exceedance (e.g. transport, including cross-border sources and formation of secondary pollutants in the atmosphere). Accurately determining emission source apportionment is important when an exceedance situation can be considered as an amalgamation of individual exceedances, which if comprised of similar source apportionment could be managed together as a macro exceedance. Source apportionment must therefore be relevant to each individual exceedance situation and be applicable to the monitoring station or modelled location with the maximum exceedance situation. It must reflect regional, urban and local contributions within the Member State and include transboundary contributions. Urban and local contributions must be further

[12] With the exception of city parks, large railway stations, urban motorways and motorway junctions, the built-up area is not mixed with non-urbanised areas

[13] http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf

divided to identify any significant sources such as transport (road traffic and shipping), industry (including heat and power production), agriculture, commercial and residential sources. It is essential to establish how the exceedance at any single location of maximum exceedance can be accounted for by contributions from the regional background, urban background increment and local increment. This categorisation helps in the selection of possible measures for the improvement of air quality including implementation, responsibility and involvement of stakeholders. Ultimately, a description of possible measures is required.

- ✓ **Previous plans and programmes** that give details of measures or projects for air quality improvement, including those which existed prior to Directive 2008/50/EC, should be reported and at which level of governance any measures were implemented; local, regional, national or international. Previously reported results can help quantify and qualify the impact of measures and inform decisions in future AQPs (see *Section 7.3.1*).

- ✓ **Details of abatement measures and any associated projects adopted with a view to reducing pollution** should each be listed and described in an AQP with an accompanying timetable for implementation. An estimate of the improvement from the baseline scenario ensuing of the AQP is required with an expected timeframe required to attain these objectives. To evaluate any improvement the baseline scenario should be established using measured and/or modelled data. This will include concentrations at the locations of exceedance and will typically require model calculations in which the future development of the regional background level, the total background level and the local source contributions are considered (see *Section 7.4*).

- ✓ **Any measures or projects planned or being researched for the long term** need to be included in detail.

- ✓ To assist in easier assimilation of material related to an AQP, **a list of all publications, documents, and associated work should be provided**.

AQPs may include also measures pursuant to Article 24, that relate to Short-Term Action Plans (see *Section 7.3.2 - Proposed measures for the improvement of Air Quality* and *Appendix III*).

4.2 Suggested structure

In Figure 4 is reported the suggested structure of the Table of Content of a City Air Quality Plan.

Figure 4 - The suggested Table of Content of an Air Quality Plan

Table of Contents of an Air Quality Plan

1.Background Analysis

- *1.1.Air Quality Assessment*
- *1.2.Population Exposure and Health Effects*
- *1.3.Emission Inventory*
- *1.4.Other Pressure elements*
- *1.5.Source apportionment*

2.Air Quality Plan objectives

- *2.1.Exceedances Areas*
- *2.2.Target Pollutants*
- *2.3.Indicators*
- *2.4.Period of reference*

3.Proposed measures to improve air quality

- *3.1.Measures to improve air quality in relation to existing Plans and Measures*
- *3.2.Possible measures for the improvement of air quality*

4.Assessing effectiveness of possible measures

- *4.1.Air Quality impacts*
- *4.2.Health impacts*
- *4.3.Climate Change Impact*

5.Selection and prioritizing measures

- *5.1.Cost-Effective Analysis, Cost-Benefit Analysis or Multi-Objective Analysis*

6.List and Comments of the Selected Measure

- *6.1.Tables or schemes with measures list and related info*

4.3 Integration with other Plans and Programmes

Directive 2016/2284/EU *of 14 December 2016 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC* ('National Emissions Ceilings Directive - NECD')

Directive 2001/42/EC *on the assessment of the effects of certain plans and programmes on the environment* ('Strategic Environmental Assessment - SEA Directive')

Directive 2011/92/EU *of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment* ('Environmental Impact Assessment - EIA Directive')

Directive 2014/52/EU *of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment* ('EIA Directive - Amended')

Air Quality Plans are the instruments through which Cities plan to adopt actions for reaching Air Quality objectives on their territory in co-operation with other authorities and economic sectors.

By means of Cities AQPs local administrations could add to the overarching (regional and national) Air Quality planning instruments important local specific measures, that cannot be managed at a higher level of governance, counting on its peculiar tasks and powers. Some example of these measures are:

- ✓ traffic - e.g. with Low Emission Zones;
- ✓ residential heating plants - punctual controls, local regulation;
- ✓ protection of sensitive population groups - e.g. reduce exposure to traffic emissions for schools and hospitals;
- ✓ land use and urban planning - e.g. reduce traffic proximity exposure for new buildings with local urban planning instruments; increasing green areas.

In the meantime, a number of measures defined as '*necessary to reach the targets*' during the elaboration of the city AQP cannot be solved solely at an urban level and should address different sectors whose enforcement and implementation could be of competence of overarching authorities, such as Metropolitan area or Agglomeration, Regions, Members Stater or EU (see also *Appendix VI – Recommendations for Air Quality Planning on good policies, governance and practices*).

Anyway, all the measures included in the AQ Plan have to be in compliance with national Plans and Programmes and in agreement with neighbouring towns and zones or cross-boarding countries and in harmonization with their plans, in particular of those related to Air Quality.

4 -What content for a City Air Quality Plan

In particular, in drafting Cities Air Quality Plans it is important the dialogue with the national level in compliance with the new **National Emissions Ceilings (NEC) Directive** (2016/2284/EU) entered into force on 31 December 2016, replacing earlier legislation (Directive 2001/81/EC). This Directive is designed to further reduce air pollution and its associated risks to the environment and human health (Art. 1) and includes for each Member State future emission reduction commitments for nitrogen oxides (NO_x), sulphur dioxide (SO_2), ammonia (NH_3), non-methane volatile organic compounds (NMVOC), and fine particulate matter ($PM_{2.5}$) emissions. Compliance with these commitments is also expected to contribute to achieving the Union's long-term objective on air quality in line with the guidelines as set out under the World Health Organisation (WHO) guidelines.

Article 6 of the NEC Directive requires Member States to establish - by 1 April 2019 at the latest - an initial **National Air Pollution Control Programme (NAPCP)** which must be regularly updated, at least every four years. The content of the NAPCP is stipulated by the Article 6 and Annex III part 1 of the NEC Directive. In accordance with Article 6 (10) of the Directive, an Implementing Act laying down a common reporting format for NAPCP is going to be adopted.

The Art. 6. of the NEC Directive requires that Member States when drawing up, adopting and implementing the NAPCP shall:

> *"(a) assess to what extent national emission sources are likely to have an impact on air quality in their territories and neighboring Member States ….;*
>
> *(b) take account of the need to reduce air pollutant emissions for the purpose of reaching compliance with air quality objectives in their territories and, where appropriate, in neighboring Member States";*

Above statements, among other things, mean that NAPCPs have to consider the assessed effectiveness of Air Quality Plans (Art. 23 of 2008/50/EC Directive) in being locally in compliance with EU limit values in 2020, 2025 and 2030 scenarios.

The approach of the NEC Directive shows that 'local point of view' should be considered as important along the preparation of NAPCP. As the 'right balance of action implementation' among different decision levels it would be important to involve also local level decision makers in the process of stakeholder consultation along the NAPCP preparation as this would guarantee a better implementation of the actions themselves later on.

Since each Member State should draw up, adopt and implement a NAPCP with a view to complying with its emission reduction commitments, and to contributing effectively to the achievement of the air quality objectives, **it is expected that adopted NAPCP should contribute to the successful implementation of Air Quality Plans established under Article 23 of Directive 2008/50/EC**.

CITIES AIR QUALITY PLANS AND NATIONAL PROGRAMMES

Republic of Croatia

Zagreb, *Source:* https://www.google.it/maps

Generally, in the Republic of Croatia, if in any given zone or agglomeration a level of pollutants in the air exceed any limit or target value, in each of these cases an action plan (Air Quality Plan) for improving the air quality for that zone or agglomeration has to be adopted by **local self-governance authority (City)** in order to ensure, as soon as possible, achievement of limit or target values.

The responsibility for **Air Quality Plan draft development** is given only to a legal persons (expert institutes that has permit/licence to perform expert tasks of development of strategic and action plan documents). Such permitting system is regulated by Environment Protection Law and permit/licence is issued by Ministry of Environment following an administrative procedure. Therefore, each local authority has to implement a limited public procurement call aiming to ensure the Air Quality Plan draft document development/drafting.

For the purpose of coordination of reporting on the AQP, a **Working group** was established at the national level by the Croatian Agency on Environment and Nature, since the Agency is the responsible institution for the e-reporting (Implementing Decision 2011/850/EC) in Croatia. The members of the group are representatives of cities that have adopted the AQP and representatives of the Agency and Ministry of Environment and Energy.

Besides the Air Quality Plans, the representative body of the County and the City of Zagreb (as regional authorities) and the big city (according to the national regulations the big city is a local self-government unit that is at the same time the economic, financial, cultural, health, transport and scientific centre of the wider part of the county, with more than 35,000 inhabitants) shall adopt a **Programme of air protection, ozone layer, mitigation of climate change and adaptation to climate**

change, which is an integral part of the environmental protection program for the county, i.e. the City of Zagreb and the big city. The program shall be published in the official gazette of the unit of local and regional self-government, depending on which of its representative body it has been issued. Program shall be adopted for a period of 5 years. A report on the program implementation has to be compiled each 4 years. The Programme (regional and of the big city) and the Air Quality Plans must be **publicly available** for obtaining opinions, suggestions and objections of the public, citizens and relevant stakeholders, NGOs and other interested groups. Through the media, the public is informed on the place where the documents are available and the manner and timing for providing opinions, suggestions and objections. The deadline for public to provide comments, suggestions and opinions may not be shorter than 30 days from the date of publication. The body responsible for the adoption of documents (County, big city or City) considers opinions, suggestions and objections submitted by the public and assesses and decides on their justification. For above mentioned documents the Strategic Environment Impact Assessment procedure is not obligatory, since these documents are related to the field of air quality (see also *Section 3.3*).

In 2015, the City of Zagreb developed and adopted its **Air Quality Plan** (see *Appendix IV* for details), defined in format and content in accordance with national legislation in which the provisions of 2008/50/EC Directive have been transposed. Besides own measures, the Action Plan of City of Zagreb also supports the continuation of implementation of measures from other city plans and programmes directed towards air protection, promotion of energy efficiency and use of renewable energy sources and energy in the territory of the City of Zagreb such as the *Programme of the City of Zagreb for the protection of air, ozone layer, climate change adaptation and mitigation* and the *Sustainable Energy Action Plan for the development of the City of Zagreb (SEAP*). Measures from the mentioned documents were defined in line with the valid national programmes, out of which for the field of air protection the *Plan for the protection of air, ozone layer and climate change mitigation in the Republic of Croatia for the 2013 - 2017 period* (OG 139/13), should be mentioned.

In the following the list of the Air Quality Plans (in Cities) and Programmes (in Counties and Big Cities) in Republic of Croatia is presented. The full reports are available on the links:

http://iszz.azo.hr/iskzl/godizvrpt.htm?pid=0&t=4
http://www.eko.zagreb.hr/default.aspx?id=247

Air Quality Plans - CITIES

- Action plan for air quality improvement in the territory of the city of Zagreb
- Action plan for improvement of air quality for city of Slavonski Brod
- Action plan for NH_3 emission reduction in city of Kutina
- Action plan for reduction of ozone levels for the city of Rijeka
- Action plan for emissions reduction of PM_{10} the city of Kutina
- Action plan for emission reduction of (PM_{10}) in city of Osijek
- Action plan for emission reducing of PM_{10} in city of Sisak

Programmes - COUNTIES AND BIG CITIES

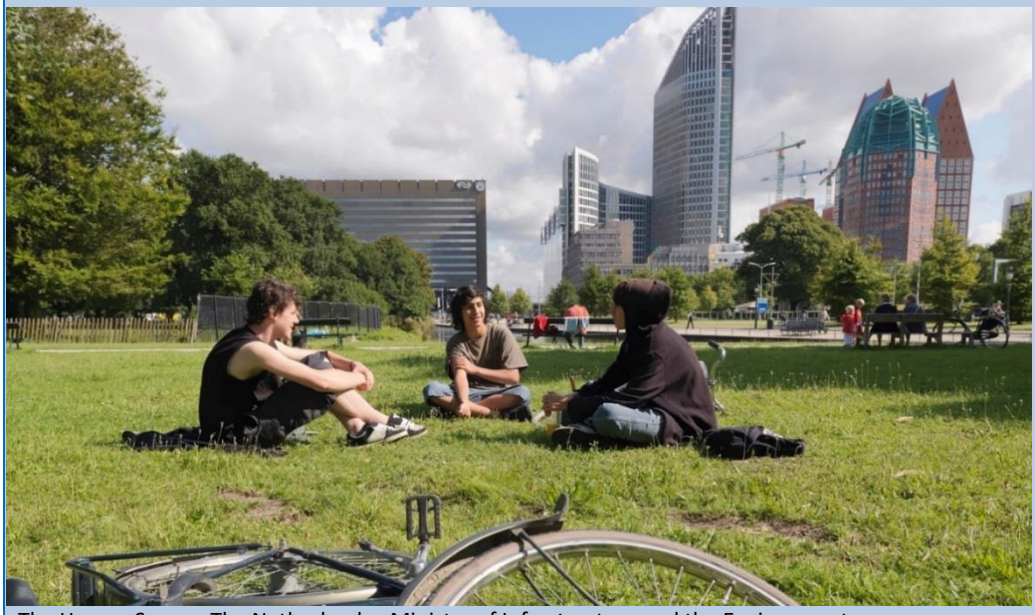
- Program of air and ozone layer protection, climate change mitigation and adaptation to climate change in Zagreb
- Program of air and ozone layer protection, climate change mitigation and adaptation to climate change for Osijek - Baranja county
- Program of air and ozone layer protection, climate change mitigation and adaptation to climate change for Sibensko-Knin county
- Protection and improvement of air quality in the Zadar county
- Protection and air quality improvement program for the Osjek - Baranja county between 2010 - 2014
- Protection and air quality improvement program for Zagreb city between 2009-2012
- Protection and air quality improvement program for Kostrena municipality
- Protection and air quality improvement program for Primorsko-Goranska county for the period 2009-2012
- Protection and air quality improvement program for Varaždin county between 2010-2013
- Protection and air quality improvement program for Koprivničko-Križevačka county between 2008 - 2012
- Protection and air quality improvement program for split - Dalmatia county
- Air quality protection and improvement program for the city Sisak 2007
- Air quality protection and improvement program for Zagreb county: http://iszz.azo.hr/iskzl/datoteka?id=74073

References:

- Air Quality Legislation in Republic of Croatia: http://www.mzoip.hr/en/environment/regulations-and-international-treaties-ratified-or-signed-by-the-republic-of-croatia.html

NATIONAL AIR QUALITY COOPERATION PROGRAMME (NSL)

The Netherlands



The Hague*, Source:* The Netherlands - Ministry of Infrastructure and the Environment

The National Air Quality Cooperation Programme (NSL) is a multilevel governance action plan to improve the air quality of the Netherlands. Participants are the national government, provinces, municipalities, and research institutes. All participants invest capacity and resources in the measures that improve air quality. The NSL includes large spatial projects that negatively impact the air quality - such as the construction of housing or roads - and counters these effects with measures that improve the air quality. The package of measures is created in such a way that the negative effects of spatial developments are amply compensated.

The goal of the NSL is to meet the European limit values for particulate matter (PM_{10}) and nitrogen dioxide (NO_2). Measures such as cleaner public transport and encouraging cycling as a means of transport, counterbalance the negative effects of construction projects, so that the European standards will still be met. In order to verify progress in the NSL programme participants conduct a yearly monitoring of the air quality and others indicators, together with info on the implementation of measures. This 'Monitoring Tool' of the NSL programme could bring to the implementation of additional measures if needed.

References:

- Air Quality Policy and Regulation in The Netherlands: https://rwsenvironment.eu/subjects/air/air-quality/
- Monitoring tool of the NSL Programme: https://www.nsl-monitoring.nl

AQP WORKING GROUPS WITH ALL DIFFERENT LEVEL AUTHORITIES

Czech Republic

Prague, *Source*: https://www.prague.eu/

- **Cooperation between all levels of governance**
  Air quality plan should involve all levels of air quality governance. The air quality plan is usually perceived as a regional/local strategy while there are numerous measures which need to be implemented in close co-operation with the state level. To reach air quality goals it is necessary to ensure co-operation especially with the state government that is empowered to mitigate air pollution, for example from road vehicles. According to the experience of the Czech Republic, it is useful to incorporate measures of the air quality plan that can be done only at the state level into a 'State Governmental Resolution' that is linked to the Air Quality Plan. This also facilitates financing the implementation of the AQPs.

- **Involving of all implementing bodies**
  Proper monitoring and co-operation between stakeholders in the implementation phase should be also borne in mind when considering best practices. The Czech Republic has introduced 'special Working Groups' that are intended to discuss the Air Quality Plan agenda and to facilitate coordination between the state and municipalities. The working groups were established by the Czech Ministry of the Environment that is also responsible for its administration. Working groups are attended by members of the Czech ministries, regional municipalities and most polluted cities. Working groups seems to be effective especially in terms of identifying barriers that hinder air quality plan implementation and their solutions.

- **Cross border co-operation**

  The Czech Republic has also introduced a 'special Working Group' to tackle Czech-Polish cross border air pollution. This working group is attended by the Czech and Polish environmental Ministries and border Regions. The working group aims mainly at sharing newly introduced measures.

  The focus is on inspiring each other, for example in creating subsidy programmes and introducing stricter environmental law that will surely contribute to decrease cross-border air pollution. Similar working groups have been established also with Germany and Slovakia.

  The Czech Republic considers that involving EU bodies more actively into these discussions would be a great opportunity.

NATIONAL/CITY REGULATION FOR SOLID FUELS BURNING

Republic of Poland, City of Krakow

Krakow, *Source*: https://www.google.it/maps

In Poland there are serious air quality problems in cities and town, mainly in the southern part.
Inadequate air quality is mainly caused by the emissions from the municipal and housing sector (old boilers and poor quality of fuel). The non-compliance with the air quality standards for fine dust PM_{10} and excessive concentration of benzo(a)pyrene is caused mainly by this sector. Studies have shown that household stoves burning bad quality coal and wood are responsible for over 50% of national PM_{10} emissions and 88% of the reasons for exceeding the annual limit value of PM_{10}; the rest being the result of vehicle emissions and other sources.

For improvement of air quality in cities are crucial new regulations on the national level, which tackle the problem of emissions from municipal and housing sector. First is the ordinance of the Minister of Finance and Development, dated 1.08.2017 regarding solid fuel boilers, which only allows new boilers that meet the requirements

of 5th class according to EN 303-5:2012 standard from July 1, 2018. The second regulation applies the quality of fuels allowed to be used in households (amendment to the Act of August 25, 2006 on the fuel quality monitoring and control system was adopted by Polish Parliament but still ordinance of the Minister of Energy is missing).

Air quality has been an issue for a long time in the city of Krakow and has inspired grass-root initiatives such as the Krakow Smog Alert (Krakowski Alarm Smogowy). Currently, Polish Smog Alert associates almost thirty grass-root organizations in Polish cities and towns advocating for clean air.

In 2015 the president of Poland signed the amendment to the Environmental Protection Act (Ustawa Antysmogowa), which gave regional and local self-governments legal instruments to tackle this problem. Since then, several regions have adopted anti-smog laws: Małopolska, Śląskie, Dolny Śląsk, Mazowsze, Opolskie, Łódzkie, Wielkopolskie, Podkarpackie and Lubuskie. Other regions are expected to adopt them in later time.

The common efforts of the Krakow Smog Alert, regional authorities and the Krakow municipality have been instrumental in rising the general awareness of the inhabitants through many initiatives and programmes, which promote better thermo-modernisation of houses, better fuels and more effective stoves.

A unique contribution to stimulating clean air came from the LIFE Integrated Project 'Implementation of Air Quality Plan for Małopolska Region - Małopolska in a healthy atmosphere', LIFE-IP MALOPOLSKA, a project coordinated by the regional authorities of the Małopolska Region in co-operation with Silesian Region, the Krakow Smog Alert, National Energy Conservation Agency, 55 municipalities and international partners from Czech Republic, Slovakia and Belgium.

Implementation of the LIFE project allowed for establishing a network of 60 Eco-managers to support the implementation of air quality actions at the municipal level, trainings and workshops for local authorities and conducting information and education campaigns at the regional and local level.

Regional Assembly of the Małopolska Region has adopted in 2016 a law banning in Krakow coal and wood as heating fuels starting September 2019 (see *Appendix V*), a radical measure for Poland.

The acceptance for these new laws by the city inhabitants would not be possible without the long and active engagement of initiatives such as the 'Krakow Smog Alert'.

References:

- https://powietrze.malopolska.pl/en/life-project/

4.4 Strategic Environmental Assessment

Directive 2001/42/EC *on the assessment of the effects of certain plans and programmes on the environment ('Strategic Environmental Assessment - SEA Directive')*

Directive 2011/92/EU *of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment* ('Environmental Impact Assessment - EIA Directive')

Directive 2014/52/EU *of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment* ('EIA Directive - Amended')

Council Directive 92/43/EEC *of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* ('Habitats Directive')

Plans and programmes must be prepared or adopted by an authority (at national, regional or local level) as controlled by legislative, regulatory or administrative provisions.

Air Quality Plans are considered by several Countries, in national transposing of the Directive 2001/42/EC of 27 June 2001, among the Plans and Programmes that require a Strategic Environmental Assessment (SEA) before approval. Anyway, legislative frameworks vary between Member States depending on their administrative structure and this affects the manner of transposing the SEA Directive. In Figure 5 the example of German legislation approach for SEA/EIA application for national Programmes, Plans and Projects is reported.

Figure 5 - SEA/EIA Field of application for Programmes, Plans and Projects in Germany (Federal German Act on EIA/SEA of 2011 - Annex 1 and 3)

Projects (Annex 1 EIA/SEA Act)	Plans (Annex 3 EIA/SEA Act)
Public and private Projects - Power plant - Industrial installations - Pipelines - Motorways - Waste inceneration plants - Mining - Deforestation - Dams - ..... Basically: any project which may harm the environment	**Public plans** Spatial Planning (State, Region, Municipality) Sectoral Planning - Nuclear waste storage plan -Traffic Infrastructure plan - Electric grid plan - Flood protection plan - Water mamagement plan - Noise reduction plan - Clean Air plan ⇦ - Waste management plan

Source: Reichter, 2015

4 -What content for a City Air Quality Plan

In general AQ plans at national and regional level require to perform a SEA process, meanwhile for cities Air Quality Plans SEA is not an obligation and is 'case by case' depending: the nature and the level of specification of measures included in the plans must be considered and the city administration would have to verify with its competent authorities if them fulfil with the criteria stated in Annex II of Dir. 2001/42/EC for which a SEA is needed (Screening).

SEA mechanism

With the objective to "contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development" (Art. 1) the SEA Directive stipulates:

- ✓ the **Screening requirements** for determining whether a SEA is required (Annex II of Directive);
- ✓ the **Scoping** arrangements to identify the most significant effects of proposed plans and programmes that require a SEA;
- ✓ the preparation and submission of an **Environmental Report** that must be made available for **Public consultation** before the adoption of any plan or programme requiring a SEA.

There is no fixed delivery mechanism in the Directive, so individual Member States are at liberty to formulate their own SEA methodologies and procedures to achieve the objectives of the Directive.

Anyway for better implementation of the SEA Directive, European Commission - DG ENV prepared a Guidance available, in different languages, at the following link:
http://ec.europa.eu/environment/eia/sea-support.htm
and also some Member States published Practical guides for the local implementation (see References).

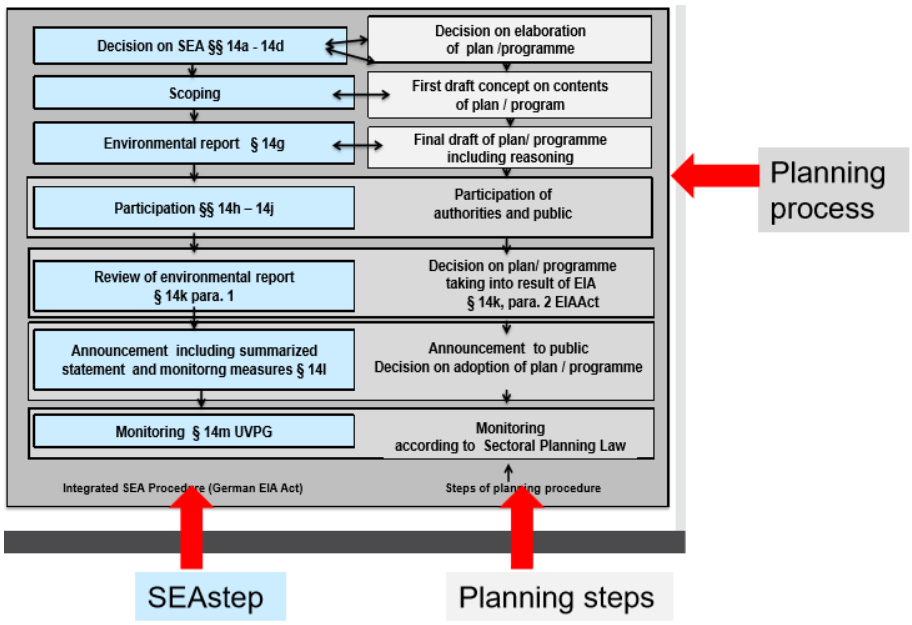
SEA as a policy-aiding tool

In Figure 6 the integration of SEA into planning or decision-making process is represented: it is clear that SEA can be considered as a policy-aiding assisting organisations, developers and authorities with the drafting and implementation of policy-making tools.

The SEA procedure is initiated when **Scoping** and **Environmental report** are prepared with any significant effects on the environment and alternatives of the proposed plan or programme identified.

The **public and the environmental authorities are informed and consulted on the Draft Plan** or programme and the **Environmental report are reviewed** on the basis of the received observations. Announcement of the Adoption of the Plan including summarized statement and forecasted monitoring measures close the process. The further step is Monitoring of the implementation of the Plan that must be done periodically.

Figure 6 - Integration of SEA into planning or decision making process in Germany (Federal German Act on EIA/SEA of 2011)



Source: Reichter, 2015

Benefits of the SEA

The advantages to perform a SEA process could be considered as in follows:

- ✓ opportunity to take into account all the environmental effects of the plan and this brings easier to an 'integrated approach' between the AQ plan and, at least, the other environmental plans;
- ✓ having a prescribed process for Public Consultation that enhance the 'transparency' of the planning process and facilitate public participation in decision-making (this in general improve effectiveness of the AQ Plan - see also Section 4.2).

Who has to perform a SEA

A SEA is mandatory for plans and programmes which set the framework for future development consent for projects listed in the EU Environmental Impact Assessment - EIA Directive (85/337/EC) (Annexes I and II) and those determined to require an assessment pursuant of the EU Habitats Directive (92/43/EC) (Articles 6 and 7). The EU explicitly states that if any plans are closely associated they can be coordinated and/or have joint procedures.

A SEA is also mandatory for plans and programmes prepared for agriculture, forestry, fisheries, energy, industry, transport, waste/ water management, telecommunications, tourism, town & country planning or land use.

Member States in whose territory the plan or programme is being prepared that may affect other Member State(s) must consult the other Member State(s). On this issue the SEA Directive follows the general approach taken by the SEA Protocol to the UN ECE Convention on Environmental Impact Assessment in a Transboundary Context.

Any plans or programmes which determine the use of small areas at local level or those which require minor modifications shall require an Environmental assessment only when the Member State determines that they are likely to have significant environmental effects. Screening is necessary for any type of plan, not already identified, to assess if any significant environmental effects are expected. The screening procedure is based on criteria set out in Annex II of the SEA Directive.

As told previously SEA is not always required for AQPs at city level, however this decision should be made by the competent authorities on a case by case basis.

Cities Examples

In London SEA implementation has been conferred to local council authorities but the screening process, for example in the Hackney Council, stated that the SEA procedure was not necessary why key policy objectives that could require a SEA had already been adopted by other strategies with completed SEAs (Box 2).

Box 2 - Example of screening process result for SEA on an Air Quality Plan[14] in London - Hackney Council (UK)

Example of screening for SEA for AQ Plan **Hackney Council (UK)**
Hackney Council produced an AQ Plan with three main policy actions: **Policy 1:** Air Quality and development management such as ensuring that air quality is appropriately dealt with during the development control process. **Policy 2:** Actions to improve air quality with the sole aim of reducing nitrogen dioxide levels and/or particulate matter levels within the borough such as promoting walking/cycling and Zero Emission Networks. **Policy 3:** Actions to reduce the Council's own impacts on air quality such as Promotion of airTEXT[15] and campaign days to the most vulnerable, residents, businesses and visitors in the borough. Under the SEA Directive Hackney Council initiated a screening process of the AQ Plan to determine if a SEA was required. A determination could not be made until three statutory consultation bodies were consulted: ✓ The Environment Agency ✓ Natural England ✓ English Heritage On the 19th June 2014 the council decided a SEA was not necessary. The authority then published a statement setting out its decision (within 28 days of the determination). This is needed even if the authority determines that a SEA is not required, and the statement must include the relevant reasons. Hackney Council informed the public and consultation bodies of its decision via air pollution and consultation webpages for an appropriate period. It cited the key policy objectives that could require a SEA had already been adopted by other strategies with completed SEAs (these had no significant environmental effects arising from the objectives). This was supported by the response from the three statutory consultation bodies.

[14] In UK Air Quality Plans are called 'Air Quality Action Plans' and follows in general the LAQM (Local Air Quality Management) process

[15] www.airtext.info/

4.5 E-Reporting Format and Requirements

Decision 2011/850/EU *Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C(2011) 9068)* ('IPR Decision'): *Art. 13; Annex II, Art. 5*

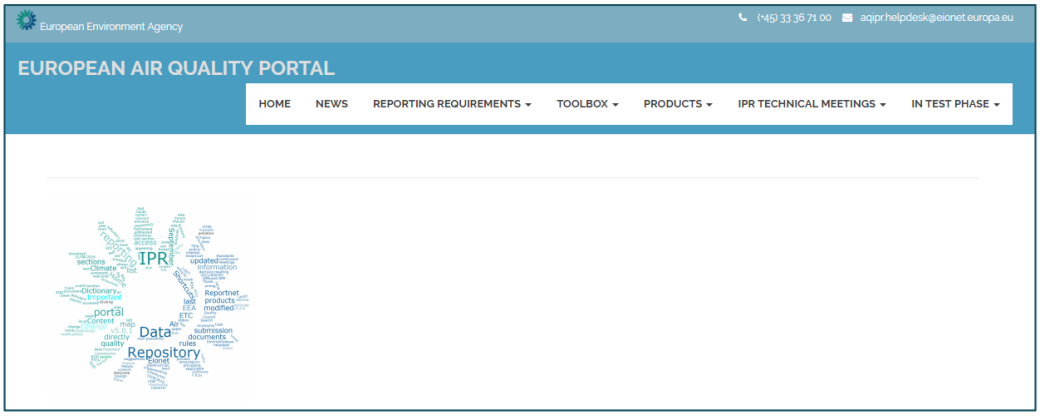
Directive 2008/50/EC *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD)

Directive 2007/2/EC *establishing an Infrastructure for Spatial Information in the European Community* ('INSPIRE Directive')

Once an AQP has been initiated, the relevant level of governance is required to compile the mandatory elements detailed under Article 23 of the AAQD following Decision 2011/850/EU and with the help of the IPR Guidelines[16]. It is mandatory that information submitted for AQPs follow the procedure outlined in Article 5 of Decision 2011/850/EU: as data will be automatically processed by an electronic tool.

The European Air Quality Portal[17] contains technical details and services that facilitate the reporting of official air quality information from EU Member States and other EEA member and co-operating countries. This information is submitted according to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council and the rules for this exchange are set out in the Commission implementing decision 2011/850/EU. The portal (Figure 7) is maintained by the European Environment Agency (EEA) as part of the EU's e-Reporting system.

Figure 7 - The European Air Quality Portal website



[16] http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf and http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance2.pdf

[17] http://eeadmz1-cws-wp-air.azurewebsites.net/

4 -What content for a City Air Quality Plan

The e-Reporting system, called '*EIONET Plans and Programmes e-Reporting System'*, is organized around 14 interconnected data flows which encompass the information necessary to meet the requirements of the Ambient Air Quality and IPR Directives (Box 3). A User Guide is available for this tool[18]. In generating data files for the e-Reporting system each country must follow standardized, INSPIRE compliant XML schemas. To support the generation of these XML reports, the JRC in Ispra have developed the e-Reporting System (PaPeRS)[19] software, this software is hosted by the EEA.

Air Quality Plans in XML format should be uploaded to the EEA's EIONET Central Data Repository by authorised national representatives under data flows H, I, J and K of Annex II of Decision *2011/850/EU* to include the mandatory elements of the AQP as listed pursuant to Article 23 of Directive 2008/50/EC in Section A of Annex XV.

AQP specific categories refer to sections H to K:

- (H) includes geographical, administrative and chronological data with appropriate references.
- defines the pollutant(s) exceeded with attributable source apportionment of the pollutant(s) in question.
- (J) defines the baseline and projected scenarios for emissions, concentrations and exceedances.
- (K) describes the available measures, responsible authorities, impacts, costs and monitoring information.

References need to be included so the public can have access to regularly updated information on the implementation of the AQPs.

Box 3 - European Air Quality Portal Dataflow

Structure of the E-Reporting system
ROD Number is the category page on EIONET site (AQP data flows) - B Information on zones and agglomerations (Art. 6) - ROD 670 - B Preliminary (Year + 1) information on zones and agglomerations (Art. 6) – ROD 693 - C Information on the assessment regime (Art. 7) - ROD 671 - C Preliminary (Year + 1) information on the assessment regime (Art. 7) – ROD 694 - D Information on the assessment methods (Art. 8 and 9) – fixed and indicative measurements - ROD 672 - D1b Information on the assessment methods (Art. 8 and 9) – models and objective estimation – ROD 742 - E1a Information on primary validated assessment data - measurements (Art.10) - ROD 673 - E1b Information on primary validated assessment data – modelled (Art. 10) – ROD 674 - E2a Information on primary up-to-date assessment data (UTD) – measurements (Article 10) – data to be provided via ftp – ROD 675 - G Information on the attainment of environmental objectives (Art. 12) - ROD 679 - H Information on air quality plans (Art. 13) - ROD 680 - I Information on source apportionment (Art. 13) - ROD 681 - J Information on the scenario for the attainment year (Art. 13) – ROD 682 - K Information on measures (Art. 13 and 14) - ROD 683

[18] http://aqportal.eionet.europa.eu/doc/UserGuide2_AQD-HK_XML_v1.pdf
[19] http://eeadmz1-cws-wp-air.azurewebsites.net/toolbox-for-e-reporting/pp-tool/

4 -What content for a City Air Quality Plan

The Commission with extensive support from the Member States and the European Environment Agency has prepared the IPR Guideline to facilitate the implementation of Decision 2011/850/EC and resultant AQPs. The IPR Guidelines Part I[20] provides descriptions of how to interpret and report the data required under Decision 2011/850/EC and IPR Guidelines Part II[21] in a tabular format with implicit instructions on which data to submit and in which format e.g. specifying whether text or URL.

Geospatial information regarding location of exceedances and subsequent plans are to be detailed under an INSPIRE option (Directive 2007/2/EC).

Data submitted via the e-Reporting system is made publicly available through several online channels. This includes the Reporting Obligations Database (ROD), which is part of *Reportnet*, a group of web applications and processes developed by the EEA to support international environmental reporting.

There are currently 149 Air Quality Plans officially submitted to the EIONET Reporting Obligations Database (ROD), and this includes national, regional and local AQPs from 22 different Member States.

The EEA Air Data Explorer for Europe (AIDE)[22] presents data submitted under data flows B to K, this covers all air quality related data including AQPs in an easily accessible format and are regularly updated with the latest information transmitted by Member States.[23]

Box 4 - Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) ***[24]***

INSPIRE - Infrastructure for Spatial Information in the European Community

INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment.

- ✓ Based on the infrastructures for spatial information established and operated by the Member States of the European Union
- ✓ Enable the sharing of environmental spatial information among public sector organizations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.
- ✓ Addresses 34 spatial data themes needed for environmental applications with full implementation required by 2021.

[20] http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf
[21] http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance2.pdf
[22] http://eeadmz1-cws-wp-air.azurewebsites.net/products/links-to-eea-website/aide-tables/
[23] aideh.apps.eea.europa.eu/
[24] https://inspire.ec.europa.eu/about-inspire/563

7 METHODOLOGIES AND TOOLS FOR ELABORATING A CITY AIR QUALITY PLAN

Directive 2008/50/EC *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD)*: Art. 23; Section A of Annex XV*

Commission Directive (EU) 2015/1480 *of 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality*

Commission Implementing Decision 2011/850/EU *of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C (2011) 9068)* ('IPR Decision')

Commission Decision of 19 March 2004 *concerning guidance for implementation of Directive 2002/3/EC of the European Parliament and of the Council relating to ozone in ambient air (notified under document number C(2004) 764)*

This Section provides useful guidance and examples of good practices for the 'elaboration phase' of the Air Quality Plan, starting from the information required by legislation (listed in Section A of Annex XV of the Directive 2008/50/EC), including an overview of available state-of-the-art methodologies and tools in the different topics, and practical examples reported in current EU cities AQPs.

The development of the AQP starts with a **Background analysis** that covers technical elements (pollutants not in compliance, main sources of pollution, contribution of local or outside the city emission sources) to define the **AQP objectives** (which pollutants must be reduced and according to which time plan).

A first list of **proposed measures to improve air quality** have to be defined, considering also overarching AQPs and local means and possibilities. The **assessment of planned measures effectiveness** is fundamental for verifying the possibility of success of the AQP, i.e. to bring urban AQ in compliance the Directive 2008/50/EC. A cost-effective analysis would be performed in order to optimize the selection/combination of measures to maximize the impact of the AQP that could be extended to citizens' health improvement and climate change mitigation.

All these steps require the use of specific methodologies and tools (models) that should inform policy development.

7 -Methodologies and tools for elaborating a City Air Quality Plan

Some scientific working groups provide analysis and methodologies to evaluate and test the robustness of models applied in assessment of AQ and scenario mode to assess the impacts of AQPs.

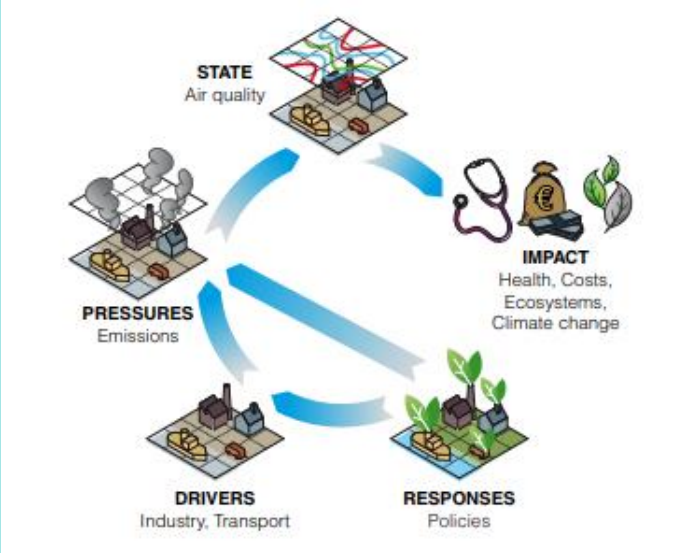
The Forum for Air quality Modelling in the European Union (FAIRMODE)[25] is developing guidelines for models to be used for estimating which sources contribute to urban air quality (Source Apportionment) and to calculate the effectiveness of reducing emissions from certain sources.

An interesting classification of methodologies and tools for assessing AQ and model scenarios has been proposed in the FP7 project APPRAISAL[26] in which the DPSIR (Driver, Pressure, State, Impact, Responses) scheme - adopted by EEA for describing interaction between society and the environment – has been extended to the elaboration of AQPs (Guariso *et al*., 2016). As illustrated in Box 5, the main components of the DPSIR scheme for air quality are: pollutant human activities (Drivers), emissions (Pressure), concentrations (State), health, cost, ecosystems, climate change (Impacts), and selection of measures to improve air quality (Response).

Box 5 - The DPSIR Framework Concept, adopted by EEA, applied to Air Quality in FP7 Appraisal Project

DPSIR Framework Concept for Air Quality

Concept helps to structure thinking about the interplay between air quality and socioeconomic activities, supports in designing assessments, policy definition, identifying indicators, and communicating results.



Source: Appraisal FP7 Project Layman's report.

The APPRAISAL classification of tools considers three different 'level of complexity' to build the different modules of the DPSIR (from the easier, level-1, to the most complex,

[25] FAIRMODE Group http://fairmode.jrc.ec.europa.eu/
[26] APPRAISAL FP7 Project, http://appraisal-fp7.terraria.com/site/index.php

level-3). The Authority elaborating the AQP should consider the opportunity to use one instead of another basing on data available and cost-effectiveness of the different approaches.

7.1 Background analysis

7.1.1 Air Quality Assessment

The starting point in the elaboration phase of the AQP is the assessment of air quality that is the evaluation of the current situation and trends in term of concentrations of different pollutants.

According to Section A - Annex XV of Dir. 2008/50/EC for areas of exceedance, the AQP has to report:

1. Localization of excess pollution

(a) region;
(b) city (map);
(c) measuring station (map, geographical coordinates).

2. General Information

(a) type of zone (city, industrial or rural area);
(b) estimate of the polluted area (km^2) and of population exposed to the pollution;

[…]

4. Nature of pollution

(a) concentrations observed over previous years (before the implementation of the improvement measures);
(b) concentrations measured since the beginning of the project;
(c) techniques used for the assessment.

5. Origin of pollution

(a) list of the main emission sources responsible for pollution (map);
(b) total quantity of emissions from these sources (tonnes/year);
(c) Information on pollution imported from other regions.

6. Analysis of the situation

(a) details of those factors responsible for the exceedance (e.g. transport, including cross-border transport, formation of secondary pollutant in the atmosphere);
(b) details of possible measures for the improvement of air quality.

Useful indication on how to fulfil the mandatory elements of the aforementioned Annex for AQPs is given by Commission Implementing Decision 2011/850/EU (IPR Guidelines)[27]. For instance, the Decision states that for point (b) also indication in term of km of road can be given. The classification of an urban area given in (a) describes the location with respect to distribution and density of building and should distinguish it from suburban and rural areas. Urban areas are continuously built-up, meaning complete (or at least highly predominant) building-up of the street front side by

[27]http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf and http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance2.pdf

buildings with at least two floors or large detached buildings with at least two floors[28] (IPR Guidelines).

Chapter II of Dir. 2008/50/EC gives legislative elements for the assessment of air quality: it shall be performed on the basis of fixed measurements that can be supplemented by modelling techniques and/or indicative measurements "to provide adequate information on the spatial distribution of the ambient air quality", if pollutants concentrations exceed upper assessment threshold; different combination of techniques are requested with different AQ levels referring to assessment thresholds.

In order to reach the level of detail needed to correctly describe the spatial variability of concentrations at urban level, in addition to measured concentrations, a geo-statistic interpolation method (at least) or a chain of air quality dispersion models, from supra-regional models to street-level ones, would be adopted for the air assessment ('nesting' techniques).

Chemical Transport Models (CTM) that include also the chemical transformation of primary pollutant to secondary ones, are considered the most suitable in representing PM_{10}, NO_2 and O_3 pollutants. These models use as input data meteorological models results and measures combined with emissions inventory data (see *Section 7.1.3*): a typical scheme of a CTM model is represented in the following Box related, as an example, to the AQP of the City of Madrid.

These complex dispersion models could be used also for the assessment of measures effectiveness (see *Section 7.4.1*), but need important computational time, thus other simplified modelling techniques have been developed, such as Source-Receptor models, that try to answer to the question related to the origin of pollution and contain synthesis of local relationship between emissions and measured concentrations. Both CTM and source apportionment techniques can be used to assess the effectiveness of AQP measures, even if with different level of accuracy.

The state of air quality described in term of concentrations for the different pollutants is the basic data used to assess population exposure, which is dealt with in *Section 7.1.2* below.

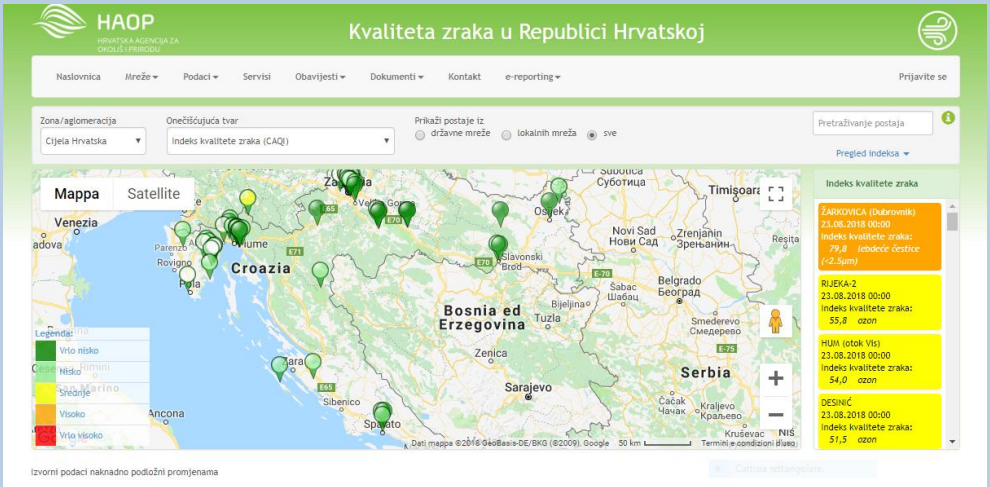
Tools used to define the origin of pollution are emissions inventory and source apportionment techniques, further developed in the dedicated *Sections 7.1.3* and *7.1.4*.

[28] With the exception of city parks, large railway stations, urban motorways and motorway junctions, the built-up area is not mixed with non-urbanised areas

AIR QUALITY DATA NETWORK

Republic of Croatia

Croatian Air Quality network



Source: http://iszz.azo.hr/iskzl/

Croatian Agency for Environment and Nature maintains the web Portal 'Air quality in the Republic of Croatia' (link: http://iszz.azo.hr/iskzl/index.html) at which the measured air pollutant concentration levels obtained from the Croatian state network for permanent monitoring of air quality are shown (monitoring is carried out by the National Reference Laboratories, control is carried out by the Ministry of Environment and Energy) and from local networks (under the competence of counties, the City of Zagreb, cities and municipalities for which measurement is carried out by accredited testing laboratories). The portal also contains validated data on concentrations of pollutants in ambient air from the state and local networks, annual reports on air quality monitoring, database of air quality improvement action plans and air protection programmes. Air quality data is delivered through the reciprocal exchange network to EEA/EC via the e-reporting system. Users have access to statistical browsers, exceedances of limit and target values as well as trends. Data is displayed in tables and graphics, and can also be downloaded (services).
By the end of 2018, modifications are planned to be carried out at the web portal 'Air quality in the Republic of Croatia' (link: http://iszz.azo.hr/iskzl/index.html) due to the new European Air Quality Index. Measured pollutant concentrations in ambient air that are delivered to the portal in real time have in the previous period also been expressed in the form of an air quality index, which is similar to CACI, precisely so that air quality issues could be more easily understood by the public.

References:

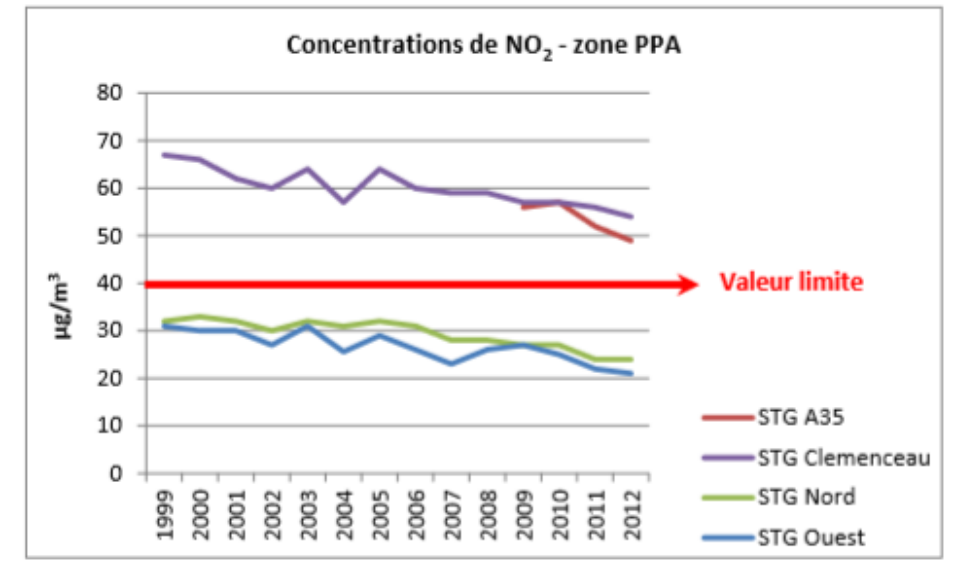
- Air quality in the Republic of Croatia - web portal: http://iszz.azo.hr/iskzl/index.html
- Assessment of Air Quality in Croatia 2011-2015: http://iszz.azo.hr/iskzl/datoteka?id=74786
- Annual reports on monitoring air quality in Croatia (national and local networks) 1999-2016: http://iszz.azo.hr/iskzl/godizvrpt.htm?pid=0&t=0

AIR QUALITY MEASURED DATA

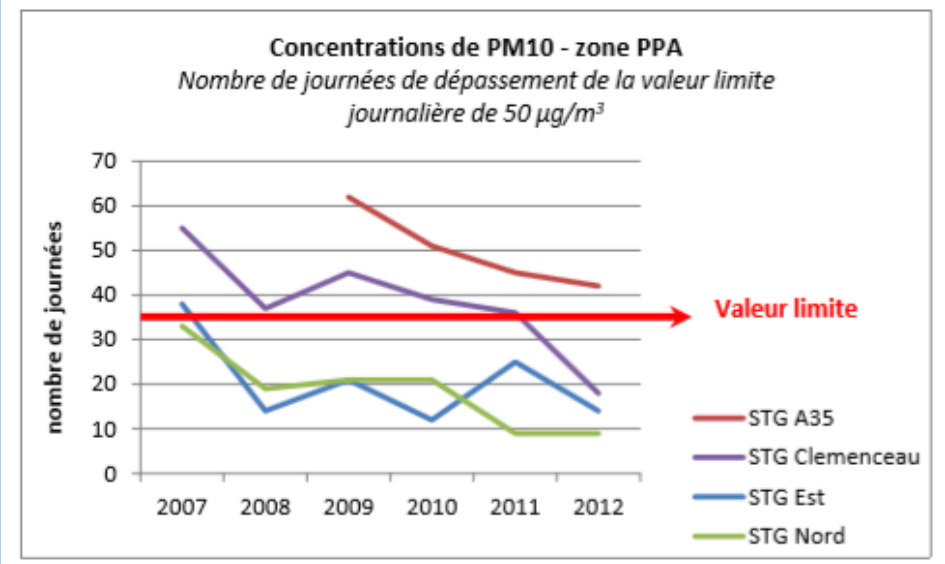
STRASBOURG Agglomeration (France) [470 000 inhabitants]

Plan de Protection de l'Atmosphère de l'Agglomeration Strasbourgeoise, 2015-2020

NO_2 annual average concentration trend



PM_{10} annual average concentrations trend



References:

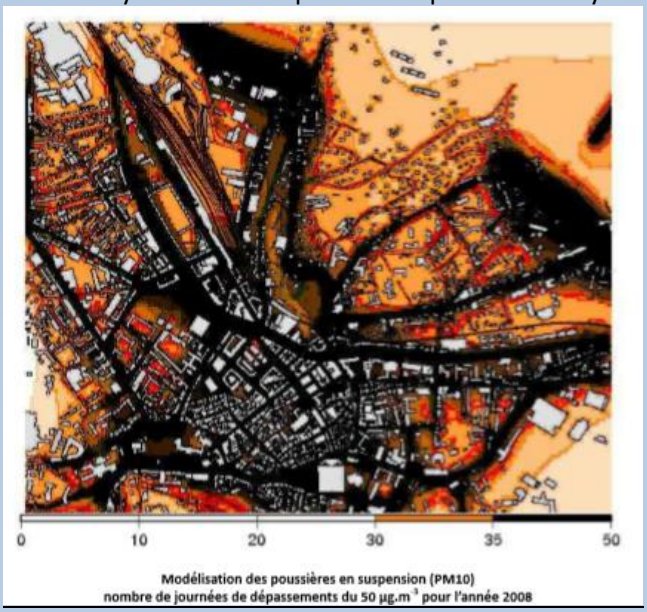
- Plan de Protection de l'Atmosphère de l'agglomeration strasbourgeoise, 2015-2020 http://www.bas-rhin.gouv.fr/Politiques-publiques/Environnement-prevention-des-risques-naturels-et-technologiques/Air/Plan-de-Protection-de-l-Atmosphere-de-l-agglomeration-strasbourgeoise-PPA

AIR QUALITY MAPS

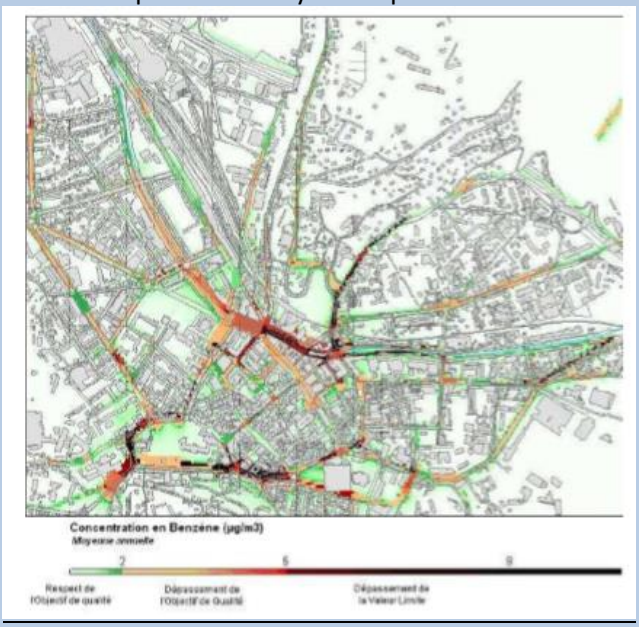
CHAMBÉRY Agglomeration (France) [121 590 inhabitants]

Plan local d'amélioration de la qualité de l'air sur le territoire de Chambéry Métropole

PM_{10} non-attainment daily Limit Value episodes map in Chambéry Métropole:



Benzene concentration map in Chambéry Métropole:



References:

- Dreal, Rhone Alpes, 2015, Plan local d'amélioration de la qualité de l'air sur le territoire de Chambéry Métropole, Document soumis à la concertation, Version du 2. févr. 2015

7.1.2 Population exposure and health effects

In Section A of Annex XV, Dir. 2008/50/EC (point 2. General Information) (b) together with estimation of the polluted area (km^2) or kilometres of road, the **description of the 'population exposed to the pollution'** is required. Furthermore (e) **'sufficient information on the type of targets requiring protection on the zone'** is required.

Considering that art. 23 states that an AQ Plan 'may additionally include measures aimed at the protection of sensitive population groups, including children' in background analysis would be included the exposure assessment to air pollutants for sites where most sensitive people stay or spend time, such as schools, hospitals, nursing homes, sports centres, etc.

A combination of monitored data and air quality dispersion modelling would help in defining the required information, together with topographic info related to the location of the sites to be protected.

In AQPs drafting a good practice could be to perform a Health Impact Assessment (HIA) for quantifying the impact of air pollution on citizens' health both for short term and long-term exposure. This tool can be used in two several phases of the plan elaboration:

- ✓ the Assessment of the current situation (this Section). In Section A of Annex XV, Dir. 2008/50/EC (2. General Information) only the description of population exposure is required, but several Air Quality Plans report also the assessment of the current situation of air quality on citizens health in term of morbidity (hospital admissions, incidence chronic bronchitis, asthma symptoms) and mortality attributable to different pollutants;
- ✓ the evaluation of the health benefit of the possible measures in order help in the prioritizing phase and in the acceptability of the AQ plan (see *Section 7.4.2.*).

The modelling of the health effect could have different spatial resolution.
Adopting a higher spatial resolution, it is possible to consider also the effects of local specific situation such as residence in the proximity to a major road and related health effects that 'adds' for the citizens to those due to exposure to regional/urban background pollutants. The APHEKOM project[29] stated that in urban areas living near a major road (< 150 meters) can be responsible of an increase/onset of chronic diseases such as an increase from 15 to 30% in asthma in children (new cases) and also higher incidence of respiratory and cardio-vascular diseases in elders (> 65 years old) (Aphekom, 2012).

In the framework of the Partnership on Air Quality a user-friendly tool has been developed to perform a HIA at cities level. For more details, literature references on HIA and the tool developed by the Partnership see *Section 7.4.2*.

[29] APHEKOM (Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe), www.aphekom.org

POPULATION EXPOSURE

STRASBOURG Agglomeration (France) [470 000 inhabitants]

Plan de Protection de l'Atmosphère de l'Agglomeration Strasbourgeoise, 2015-2020

The map of concentration for different pollutants is obtained through air quality dispersion models; by crossing these data with population distribution it is possible to obtain the population exposure assessment to concentrations exceeding the EU Limit and target values, e.g. for PM_{10} and NO_2 as reported in the following.

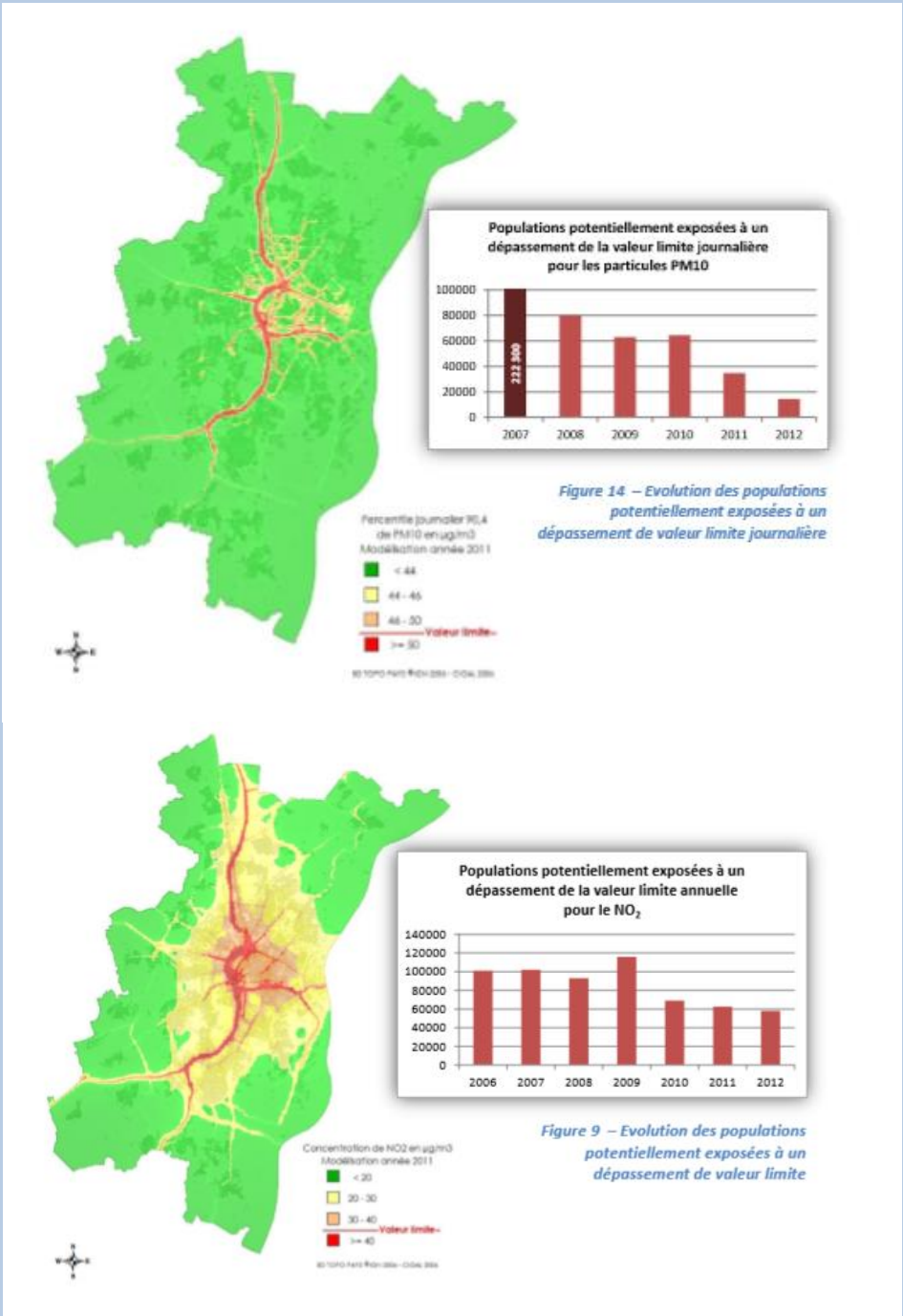
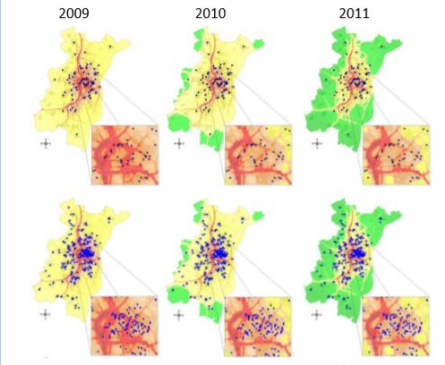
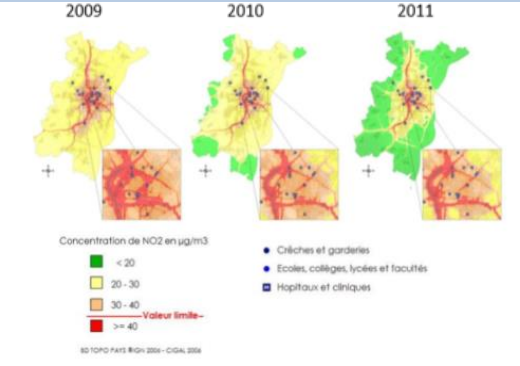


Figure 14 – Evolution des populations potentiellement exposées à un dépassement de valeur limite journalière

Figure 9 – Evolution des populations potentiellement exposées à un dépassement de valeur limite

AQP maps are furtherly produced to represent the exposure of schools, hospitals, nursing homes, sports centres to the different not in compliance pollutants. Schools and hospitals exposure to different NO_2 concentration levels are reported in the following example.





The number and percentage of different locations to be protected from air pollution exposure are reported in a table referring to those situated in areas with non-attainment of EU Limit values.

Etablissements *(nombre et %) (superficie et % pour les établissements sportifs)*	2009	2010	2011	2012
Crèches (n^b / %)	21 (19%)	8 (7%)	5 (5%)	0 (0%)
Scolaires (n^b / %)	80 (18%)	32 (7%)	27 (6%)	5 (1%)
Hôpitaux (n^b / %)	12 (38%)	2 (6%)	1 (3%)	2 (6%)
Etablissements sportifs (superf. / %)	109 000 m^2 (7%)	91 000 m^2 (6%)	75 000 m^2 (5%)	48 000 m^2 (3%)
Maisons de retraite (n^b / %)	6 (8%)	2 (3%)	1 (1%)	0 (0%)

References:

- Plan de Protection de l'Atmosphère de l'agglomeration strasbourgeoise, 2015-2020 http://www.bas-rhin.gouv.fr/Politiques-publiques/Environnement-prevention-des-risques-naturels-et-technologiques/Air/Plan-de-Protection-de-l-Atmosphere-de-l-agglomeration-strasbourgeoise-PPA

7.1.3 Emission inventory and projections

To understand the emission sources that need to be regulated with measures for compliance with the targets of the Air Quality Plan, the following information are required by Section A of Annex XV of the Directive 2008/50/EC:

5. Origin of pollution

(d) list of the main emission sources responsible for pollution (map)

(e) total quantity of emissions from these sources (tonnes/year)

(f) Information on pollution imported from other regions.

The present paragraph deals with the methods and tools available to generate the requested info listed in the bullet point 5. (a) and (b) and also the scenarios assessment needed to manage the choice of the measures to be adopted, considering their impact on air quality as required at bullet point 8. (c) - **estimate of the improvement of air quality planned and of the expected time required to attain these objectives**. Emissions produced in different scenarios are, in the latter case, the input data for air quality modelling such as dispersion models (see *Section 7.4.1*).

Emissions are one of the most important Pressure elements in the DPSIR concept model to assess the effect (Impact) on air quality (State) of different human activities (Drivers) and related policies (Responses).
Emissions are evaluated starting with collection of human Activity data (or Drivers), multiplied for the specific Emission factor, that is expressed in term of gram or kg of emission in relation to the unit of activity (e.g. km for traffic, kWh for energy sector, etc) and would consider different fuel, technology adopted for pollutant abatement, age of source and so on:

Emissions = Emission Factor x Activity data

Emission sources must be categorized in coherence with the classification required by the e-reporting system (see *Section 4.5*).

Emissions on the territory of competence can be assessed and modelled using the EMEP/EEA Guidebook (EMEP/EEA, 2016)[30] a technical guidance for preparing national emission inventories, which provides detailed information and suggests approaches with different level of complexity (*Tier levels*).

At urban level it is important to use all the geospatial information available in order to have a correct overview of the local emission situation and act where it is necessary to reduce AQ concentrations with benefit for population exposure. A '*bottom-up*' approach in emission inventory at urban scale is desirable, as the disaggregation obtainable from the regional emission inventory ('*top-down*' approach) using proxies for several variables is not always representative for a city.

[30] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

7 -Methodologies and tools for elaborating a City Air Quality Plan

In the following are explained examples, of methods that can be adopted for traffic emission modelling, being traffic generally one of the most important source at urban scale, considering the related impact for on citizens' health (Aphekom, 2012).

The tools to model emissions (both for the base case and policy scenarios) can vary between simple spreadsheet-models to the use of various kinds of geo-based traffic emission models. Traffic emission models can be less or more complex, depending on the spatial scale of approach (city area or street level), consideration of traffic patterns and if and how travellers' behaviour is included.

Traffic emission scenarios modelling would include a local extrapolation of trends in car use, fuels used, in modal split and in replacement pace of older vehicles by new ones. Furthermore, spatial traffic circulation features and changes in circulation patterns and schemes (Limited Traffic Zones, pedestrian areas, zero emission zones, etc.) must be considered for each scenario. An approach with a higher level of complexity would include behaviour of travellers, where the choice of travel modes and routes is driven by the desire to use the fastest or cheapest way to come from A to B. Such a model would enable to assess the impacts of investments in public transport, or in the use of economic instruments (such as road pricing or parking fees).

For traffic emission, the EMEP/EEA Guidebook refers to the Computer Programme to calculate Emissions from Road Transport (COPERT)[31] emissions factors and methodology. Another source of emission factors for traffic, used in current AQPs, is the Handbook Emission Factors for Road Transport (HBEFA),[32] which covers a wide variety of traffic situations.

For non-traffic sources such as domestic heating, shipping, agriculture or industrial sources, projected emissions are related to a proxy (e.g. population, GDP or sectoral production) multiplied by an emission factor. The emission factor would ideally depend on the age of the installations and end-of-pipe abatement measures that are obliged.
Future emissions projections for scenario impact assessment would consider data of the **National Air Pollution Control Programme (NAPCP)** that would be prepared by any Member State by April 2019, implementing the NEC - Directive[33]. At the same time, emission inventories compiled at urban level would improve the quality of regional and national emission inventory, reducing the level of their uncertainty.

In the boxes below there are examples of good practices implemented in several cities for evaluating and representing emissions inventory and projections at urban level.

[31] COPERT - COmputer Programme to calculate Emissions from Road Transport, www.emisia.com/copert
[32] HBEFA - Handbook Emission Factors for Road Transport, http://www.hbefa.net
[33] Dir. 2016/2284 of 14 December 2016.

EMISSION INVENTORY

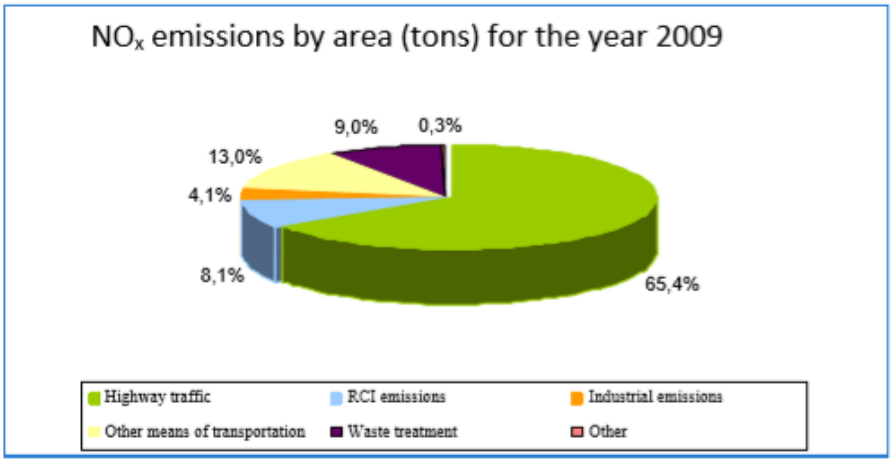
City of MADRID (Spain) [3 141 991 inhabitants]

Example for NO_x emissions assessment results from the Madrid's Emissions Inventory

2.7 NO_x emissions (tons)

SECTORS	1990	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Residential, commercial and institutional combustion	2.073	1.754	1.715	1.665	1.616	1.687	1.767	1.785	1.716	1.731	1.745	1.661
Industrial combustion plants	3.552	1.854	1.739	1.562	1.504	1.414	981	959	978	994	962	837
Road transport	26.215	22.800	22.212	21.040	20.874	19.593	20.410	20.109	18.162	16.132	14.684	13.375
Other means of transport	1.668	2.063	2.379	2.507	2.393	2.523	2.677	2.761	2.797	2.977	2.864	2.655
Waste treatment and disposal	62	594	614	609	883	1.781	2.437	2.311	2.032	1.606	1.940	1.848
Other	77	91	101	89	92	99	108	107	128	126	116	69
SECTOR TOTALS	**33.648**	**29.156**	**28.759**	**27.471**	**27.362**	**27.098**	**28.381**	**28.032**	**25.814**	**23.565**	**22.312**	**20.445**

1.6. NO_x emissions structure of the City of Madrid



Source: *Emissions Inventory of Madrid City. 2011 Ed.*

Sectors	SNAP Groups
Residential, commercial and institutional combustion (R&C&I)	02 Non-industrial combustion plants
Industrial combustion plants	03 Combustion in manufacturing industry
Road transport	07 Road transportation
Other means of transport	08 Other mobile sources and machinery
Waste treatment and disposal	09 Waste treatment and disposal
Other	04 Industrial processes (without combustion) 05 Extraction and distribution of fossil fuels and geothermal energy 06 Solvent and other product use 10 Agriculture 11 Other sources and sinks (Nature)

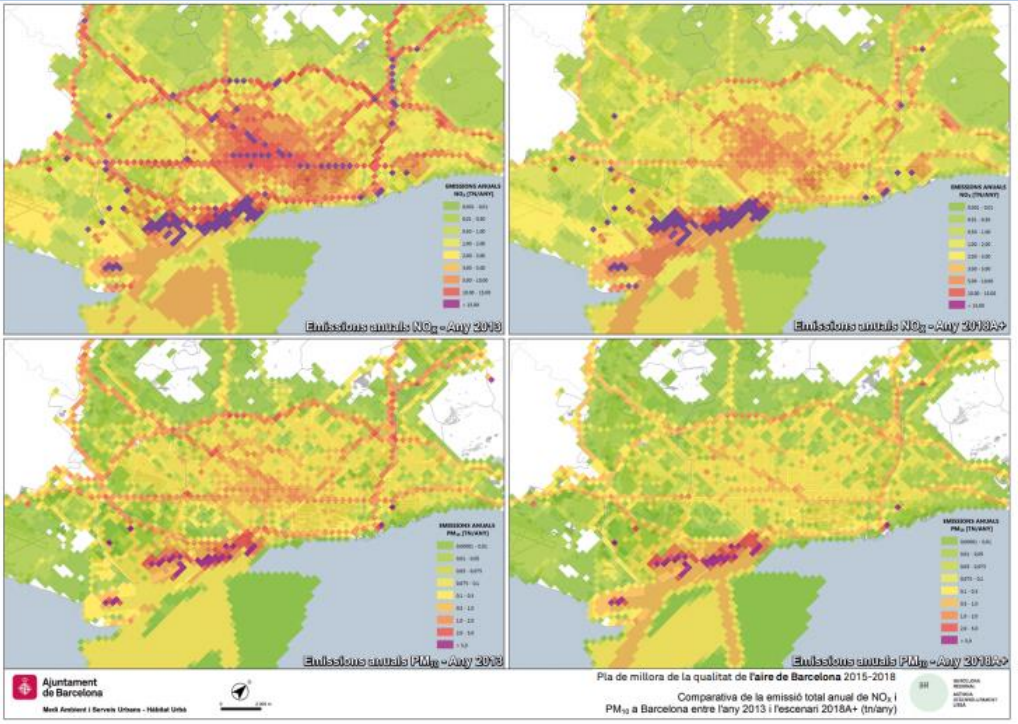
References:

- Madrid's Air Quality Plan 2011-2015, https://www.madrid.es/UnidadesDescentralizadas/AreasUrbanas_EducacionAmbiental/Catalogo/AirQualityPlan2011-15.pdf

EMISSIONS SCENARIOS MAPS

City of BARCELONA (Spain) [1 620 809 inhabitants]

Emissions scenarios for NO_2 and PM_{10}: base case (left) and AQP scenario (right)



References:

- Plan to improve air quality in Barcelona 2015-2018, https://ajuntament.barcelona.cat/qualitataire/sites/default/files/pdfs/PMQAB_EN_2014.pdf

7.1.4 Source apportionment

Another fundamental step to prepare an AQP is the **identification of main sources of pollution**, both in terms of 'geographical' and 'sectoral' sources. Such information is essential to reply to questions like:

- ✓ How do urban sources contribute to the average concentrations?
- ✓ What is the contribution of sources outside the city?

and last but not least,

- ✓ What is the additional contribution of local sources to the air quality, i.e. traffic along busy roads?

With source apportionment techniques it is possible to try and understand the link between air quality situation (or State) given in term of concentration measured (or obtained by model for a given area) and the sources (or Drive), whose contribution is given in term of emissions (Pressure).

This knowledge is essential to identify the most effective possible measures for the AQP. To that end, the AAQD requires the following information:

5. Origin of pollution

(a) list of the main emission sources responsible for pollution (map)
(b) total quantity of emissions from these sources (tonnes/year)
(c) Information on pollution imported from other regions.

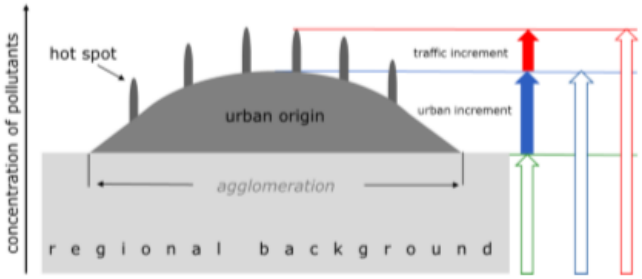
In particular, source apportionment techniques help in defining both information related to point (c) and the following:

6. Analysis of the situation

(a) details of those factors responsible for the exceedance (e.g. transport, including cross-border transport, formation of secondary pollutant in the atmosphere);

Considering a simplified approach, in Figure 8 a schematic representation of the contribution to urban concentrations of pollutants by source at different geographical scale is given: filled arrows represent urban increment and traffic hot-spot increments versus concentration attributable respectively to regional background and urban background.

Figure 8 - Schematic representation of the contribution of different scale sources to urban concentrations of pollutants



Source: In Belis et al., 2014, modified from Lenschow et al., 2001

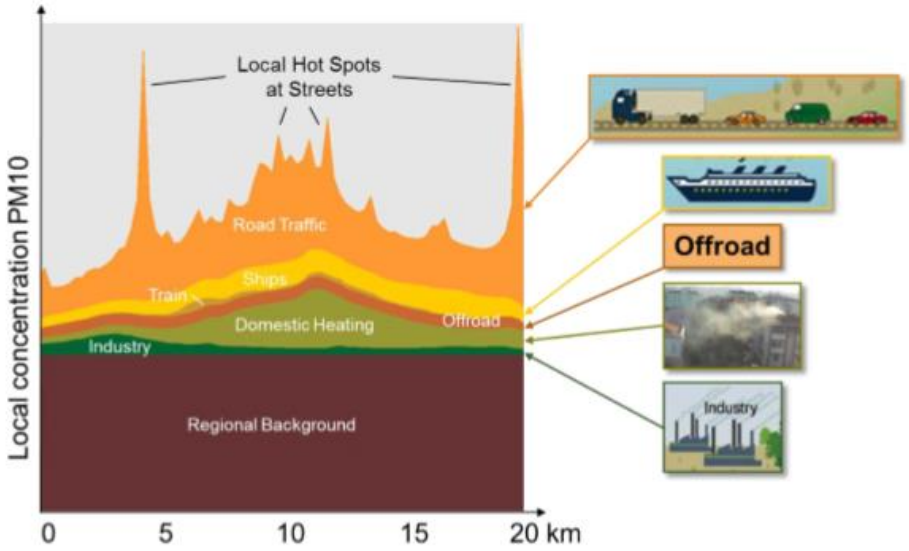
Figure 9 displays a cross West-East section of the German city of Cologne that shows the assessed spatial contribution of different local emission sources and of the regional background to city concentrations of PM_{10}, starting from source apportionment techniques data.

However, in the real world different geographical scale sources contributors are not so clearly separated and they can influence/contribute each other[34]. Therefore, referring to technical protocols defined by the FAIRMODE group[35] and related Guidances [34,36] to

[34] Thunis P., 2018, *On the validity of the incremental approach to estimate the impact of cities on air quality*, Atmospheric Environment, Volume 173, January 2018, Pages 210-222
[35] FAIRMODE Group http://fairmode.jrc.ec.europa.eu/
[36] Belis C., *et al.* 2014, *European Guide on Air pollution Source Apportionment with receptor models*, JRC, Report EUR 26080 EN, ISBN 978-92-79-32513-7, doi: 10.2788/9307

correctly assess the city contribution on local concentration on which define air quality planning strategies is a good practice.

Figure 9 - Cross section West to East City of Cologne, DE



Source: U. Hartmann

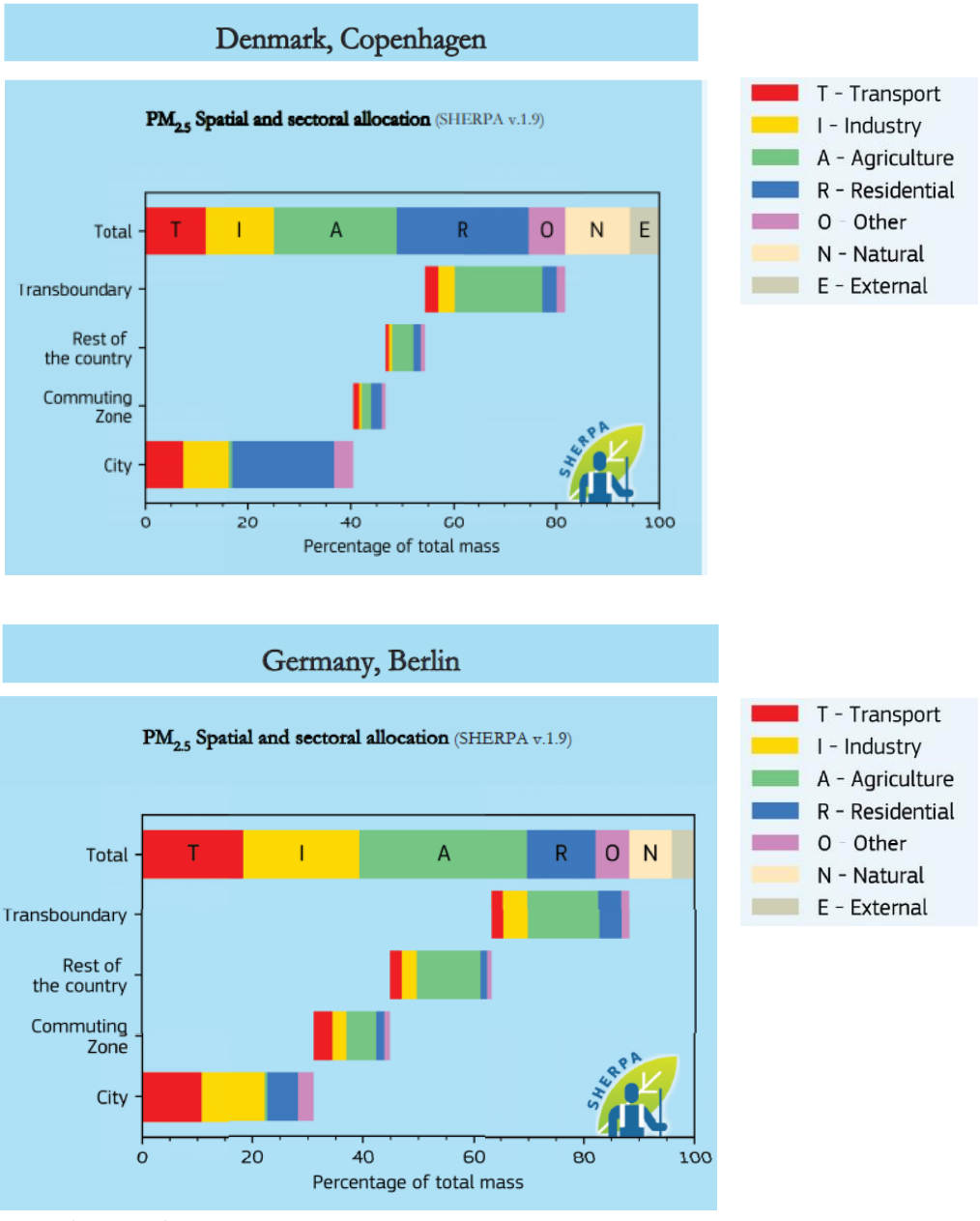
Accurately determining emission source apportionment is important when an exceedance situation can be considered as an amalgamation of individual exceedances, which if comprised of similar source apportionment could be managed together as a macro exceedance (adopting measures on a sector and city area). Source apportionment must therefore be relevant to each individual exceedance situation and be applicable to the monitoring station or modelled location with the maximum exceedance situation.

A useful computational tool, developed by Joint Research Centre of the European Commission is SHERPA (Screening for High Emission Reduction Potential on Air quality) that makes possible to rapidly explore geographical and sectorial sources of different pollutants and also provides simplified analysis for the assessment of efficacy of AQ measures (see *Section 7.4.1*). Using this computational tool, JRC developed an Atlas (JRC, 2017)[37,38] where $PM_{2.5}$ source allocation for 150 EU cities is quantified, referring to 'urban background' stations. In Figure 10 is possible to observe how can be different the role of cities emissions in respect to the overarching geographical level of action. In some contexts, it is particularly important to act locally. This is true in general for NO_2 emissions, generated mainly by traffic in urban areas.

[37] P. Thunis, B. Degraeuwe, E. Pisoni, M. Trombetti, E. Peduzzi, C.A. Belis, J. Wilson, E. Vignati, Urban PM2.5 Atlas - Air Quality in European cities, EUR 28804 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73876-0, doi:10.2760/336669, JRC108595
https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/urban-pm25-atlas-air-quality-european-cities

Because of the non-linearity of the chemical formation of secondary PM this source apportionment does not always correspond with the effectiveness of measures. See in next figures examples of good practices implemented in several cities for source apportionment.

Figure 10 - $PM_{2.5}$ source apportionment based on the SHERPA tool for two large EU cities (Copenhagen and Berlin).



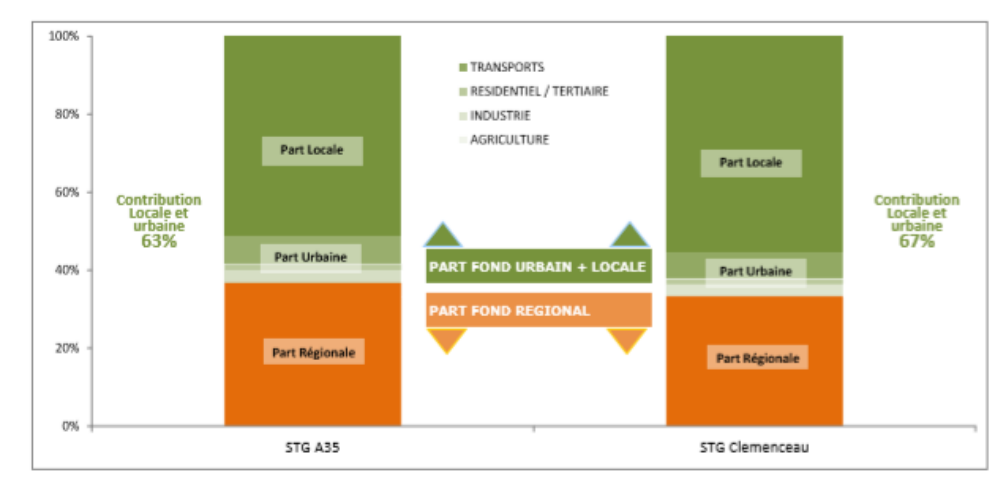
Source: Thunis et al., 2017

SOURCE APPORTIONMENT

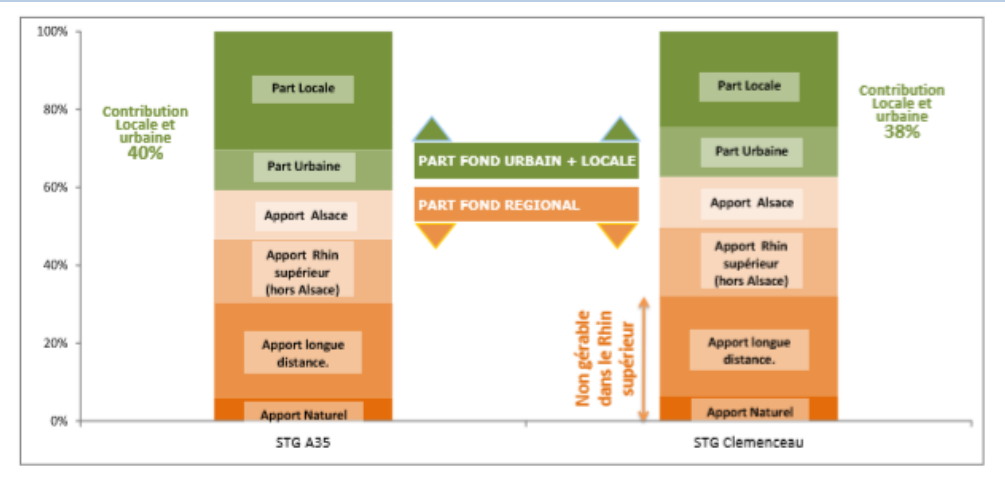
STRASBOURG Agglomeration (France) [470 000 inhabitants]

Plan de Protection de l'Atmosphère de l'Agglomeration Strasbourgeoise, 2015-2020

NO_2 concentrations source apportionment



PM_{10} concentrations source apportionment



References:

- Plan de Protection de l'Atmosphère de l'agglomeration strasbourgeoise, 2015-2020 http://www.bas-rhin.gouv.fr/Politiques-publiques/Environnement-prevention-des-risques-naturels-et-technologiques/Air/Plan-de-Protection-de-l-Atmosphere-de-l-agglomeration-strasbourgeoise-PPA

SOURCE APPORTIONMENT

City of BERLIN (Germany) [3 711 930 inhabitants]

Air Quality Plan for Berlin 2011-2017

For each street the contribution of different type of vehicles has been derived with help of specific techniques.

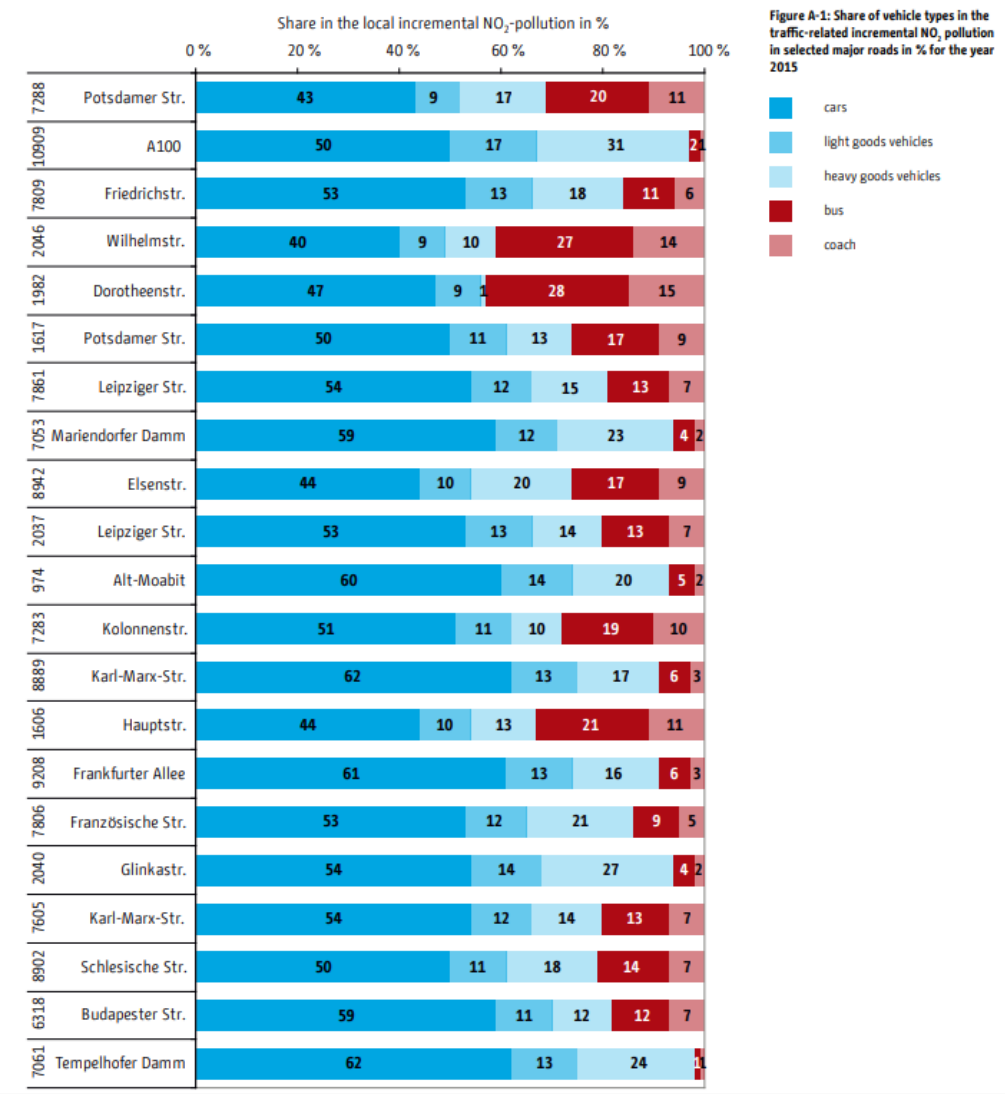


Figure A-1: Share of vehicle types in the traffic-related incremental NO_2 pollution in selected major roads in % for the year 2015

References:

- Air Quality Plan for Berlin 2011-2017 https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

7.1.5 Other pressure elements

Other pressure elements that can influence air quality levels in a given area, in a current situation and in scenarios, would have to be considered in the elaboration of the AQP. The main examples are listed in the following:

- ✓ Topography and orography of the territory can deeply influence its atmospheric dispersions capability (a closed basin surrounded by mountains or a deep valley would have lower dispersive conditions that an open flat land). At urban level height of buildings can influence local dispersion at microscale.
- ✓ Dispersion due to local meteorological situation or climate (e.g. wind field characteristic, precipitation regime or frequency of thermal inversions)[39].
- ✓ Climate Change can have a deep impact on local climate current situation and forecast (i.e. IPCC RCP scenarios [40]) with precipitation regime change, variability in dry periods, changing in synoptic circulation that can deeply influence high pressure regimes and consequent frequency of thermal inversion and related lower atmospheric dispersion capability.

Some of these elements have to be reported in the list of General information required by Section A Annex XV Dir. 2008/50/EC:

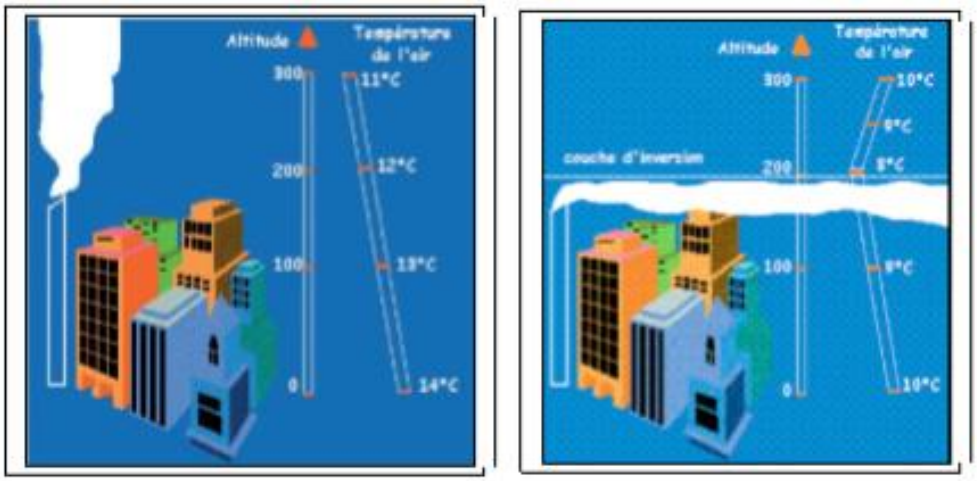
2. General Information

[…]

(c) useful climatic data

(d) Relevant data on topography

Figure 11 - Thermal inversion effect on air pollution dispersion features[41]



En situation normale la température de l'air diminue avec l'altitude. L'air chaud contenant les polluants tend à s'élever naturellement (principe de la montgolfière).
Les polluants se dispersent ainsi verticalement.

En situation d'inversion de température, le sol s'est refroidi de façon importante pendant la nuit (par exemple l'hiver par temps clair, le matin). La température, à quelques centaines de mètres d'altitude, est alors supérieure à celle mesurée au niveau du sol. Les polluants se trouvent ainsi piégés sous un effet de « couvercle » d'air chaud.

Source: Préfet de la Region de l'Ile-de-France, Préfet de Paris, 2013

[39] An interesting source of information can be the COPERNICUS project website: http://www.copernicus.eu
[40] http://www.ipcc.ch/
[41] Préfet de la Region de l'Ile-de-France, Préfet de Paris, 2013, Plan de Protection de l'Atmosphére pour l'Ile-de-France, Revision approuvée le 25 mars 2013.

7.2 Air Quality Plan objectives

7.2.1 Exceedances Areas

Based on the AQ assessment (described in *Section 7.1.1*) it is possible to answer to the request of Section A - Annex XV of Dir. 2008/50/EC on localization of excess pollution. The assessment makes it possible to well identify compliance gaps with EU legislation standards for AQ and consequently act with AQP measures.

7.2.2 Target Pollutants

AQP targets pollutants are generally presented at the beginning of the AQP document as a consequence of the AQ assessment results (*Section 7.1.1*), and are those which, given a not-attainment, it is necessary to correct in the framework of the AQP for obtaining the full compliance of AQ limit and target values defined in AAQD (or the maintenance of compliance). For areas where these values are complied with, or to better protect most sensitive people from air pollution it would be a good practice to have as a further objective of the AQP, the achievement of WHO Guideline[42] values for pollutants not aligned with them.

In Europe at urban level the most common concern is the reduction of NO_2 concentrations, mainly due to vehicular traffic. PM_{10} and $PM_{2.5}$ are pollutants to be reduced in areas where lower quality fuels are still burned (e.g. coke in industrial plant, bio-mass burning for residential heating), sometimes accompanied by benzo(a)pyrene exceedances. PM_{10} and $PM_{2.5}$ exceedances can be also be problems in areas with unfavourable dispersion conditions, where also secondary formation of PM is higher or in Northern countries, where exceedances in winter can be linked to the use of studded tire. O_3 non-attainments are an issue, in summer, for Southern countries and have to be faced with a multilevel governance approach up to transboundary scale.

7.2.3 Indicators

The assessment of air quality for the area of interest of the AQP leads to the definition of which are the pollutant to be addressed with the plan's measures (target pollutant). Indicators of the AQP that have to be defined for the management of the plan, particularly for the monitoring phase of the process (*Section 6.4*). It is important to include in the selection of indicators all the pollutants resulted not in compliance with EU legislation (or near the Limit or Target Values, in the case of AQP drafted for maintenance of air quality level) or WHO Guidelines for which the AQP is activated.

7.2.4 Period of reference

Usually AQP have a duration of about four, five years, during which they have to be monitored and updated, in order to achieve the compliance of Limit and Target Values or and/maintain/improve air quality level. The monitoring procedure is described in *Section 6.4*.

[42] WHO, 2006: Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulphur dioxide', http://www.euro.who.int, ISBN 92 890 2192 6

7.3 Measures to improve air quality

> ***Directive 2008/50/EC*** *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD): *Art. 23; Section A and Section B(3) of Annex XV*

The first step in the analysis aiming at defining measures to improve air quality, is related to the listing of measures already planned or putted implemented by the local authority that could bring a reduction of ambient air quality concentrations, and the assessing of their impact (*Section 7.3.1*).

In the consequent section of the AQP, the additional measures that can help to reduce concentration for the AQP target pollutants (*Section 7.2.2*) in the view of fulfilling AAQD or maintain/improve AQ level, must be described (*Section 7.3.2*). The list of proposed measures is then subject to the assessment of effectiveness in reducing concentration of the different target pollutants and related impact (*Section 7.4*).

7.3.1 Measures to improve air quality in relation to existing plans and measures

As requested by Section A - Annex XV of Dir. 2008/50/EC the AQP must contain:

1. Details of those measures or projects for improvement which existed *prior to 11 June 2008*[43]*, i.e.:*

(a) **Local, regional, national, international measures**;

(b) **observed effects of these measures**.

In this section of the AQP a recognition of all the actions and measures already planned or implemented that could bring a reduction of the targeted pollutants in term of concentrations for the area of interest have to be reported. Thus, every kind of measure, plan or programme, also at overarching level, would have to be cited if considered of relevance for air quality of the territory. For city authorities, existing measures with effects related to air quality can be, for instance, the Sustainable Urban Mobility Plan (SUMP) or the Sustainable Energy Action Plan (SEAP), to be cited and described with the related assessed impact on concentration levels.

The sectors that those activities could influence on air quality in an urban area are numerous, thus in addition to mobility sector and energy one, also the following themes could be taken into consideration: urban planning, construction machinery, technologies testing for pollution abatement, awareness-raising of citizens on air pollution, improvement of AQ monitoring network, etc.

[43] 11 June 2008 is the date of entry into force of Dir. 2008/50/EC.

7.3.2 Proposed measures for the improvement of air quality

> ***Directive 2008/50/EC*** *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD): *Art. 23; Section A and Section B(3) of Annex XV*

Dir. 2008/50/EC in Section A asks for:

6. Analysis of the situation

(a) details of those factors responsible for the exceedance (e.g. transport, including cross-border transport, formation of secondary pollutant in the atmosphere);

(b) details of possible measures for the improvement of air quality.

8. Details of those measures or project adopted with a view to reducing pollution *following the entry into the force of this Directive:*

(a) Listing and description of all the measures set out in the project;

(b) Timetable for implementation;

(c) Estimate of the improvement of air quality planned and of the expected time required to attain these objectives.

9. Detail of the measure or projects planned or being researched for the long term.

Dir. 2008/50/EC in Section B (3), third bullet point[44], lists a series of measures that can be taken as reference in the case of non-attainment situation for these two pollutants (nitrogen dioxide and benzene), which are here reported as useful examples and a starting point:

(a) Reduction of emissions from stationary sources by ensuring that polluting small and medium sized stationary combustion sources (including for biomass) are fitted with emission control equipment or replaced;

(b) Reduction of emissions from vehicles through retrofitting with emission control equipment. The use of economic incentives to accelerate take-up should be considered;

(c) Procurement by public authorities, in line with the handbook on environmental public procurement, of road vehicles, fuels and combustion equipment to reduce emissions, including the purchase of:

- new vehicles, including low emission vehicles;
- cleaner vehicle transport services;
- low emission stationary combustion sources;
- low emission fuels for stationary and mobile sources;

(d) measures to limit transport emissions through traffic planning and management (including congestion pricing, differentiated parking fees, or other economic incentives; establishing low emission zones)

(e) measures to encourage a shift of transport towards less polluting modes;

(f) ensuring that low emission fuels are used in small, medium and large scale stationary sources and in mobile sources;

[44] This point of the Annex is related to Postponement (Art. 22 of Dir. 2008/50/EC) cases but measures cited can be taken as examples given by legislator.

(g) measures to reduce air pollution through the permit system under Directive 2008/1/EC, the national plans under Directive 2001/80/EC, and through the use of economic instruments such as taxes, charges or emission trading;
(h) where appropriate, measure to protect the health of children or other sensitive groups.

The Catalogue of Air Quality Measures[45] supplied by the Joint Research Centre (JRC) is an internet-based resource providing useful information and examples of air quality measures. This tool, describing successful and unsuccessful measures, can be used as an interesting source of inspiration.

Box 6 - European Commission Catalogue of Air Quality Measures

Catalogue of Air Quality Measures (online resource)

Provided by the Joint Research Centre for the European Commission

- ✓ Supports the implementation of the Air Quality Directive by providing a selected number of successful (best practice) and unsuccessful Air Quality measures.
- ✓ Database is intended for officials responsible for air quality assessment, planning and management on the national, regional and local level.
- ✓ Examples include successful measures such as traffic limitation schemes (Low Emission Zones, Congestion Charging, etc.), new vehicle technologies implementation, heating supply innovative regulatory strategies and unsuccessful ones.

In *Appendix V* of the present publication several examples of good practice, and sometime innovative, air quality measures are given (see Figure 12) as source of inspiration for urban authorities that are drafting their own AQP. In *Appendix V* some examples listed in the JRC Catalogue of Air Quality Measures are also described. In the following blue boxes, and in *Section 7.6*, some good practice examples in current AQP for presenting AQ measures are given.

In the framework of the AQP elaboration, the development of an **Air Quality Municipal Regulation** could be a good practice with the scope to act timely on some intervention, with immediate improvement of air quality and shortening citizens' exposure to exceedances (see Appendix V, City of Kraków example).

AQPs may include **'Short-Term Action Plan' Measures** that aim to address high pollution episodes (days or weeks) and to thus mitigate the effects of current or predicted exceedances of one or more Alert thresholds or one or more Limit values or Target values (see *Section 3.1*).

Examples of measures that can be included in Short-Term Action Plan are given in the Art. 24 of Directive 2008/50/EC as in the follow:

- To control and suspend, where necessary, activities which contribute to the risk of the respective limit values/target values/alert thresholds being exceeded.

[45] JRC Catalogue of Air Quality Measures http://fairmode.jrc.ec.europa.eu/measure-catalogue/

- Those Plans may include measures in relation to motor-vehicle traffic, construction works, ships at berth, the use of industrial plants or products and domestic heating.
- Specific actions aiming at the protection of sensitive population groups, including children, may also be considered in the framework of those plans.

In the drawing up of such Short-Term Plans for Ozone non-attainment of Alert Threshold (240 μg/m^3 measured or predicted for three consecutive hours) Member States shall comply with Decision 2004/279/EC concerning Guidance for implementation of Directive 2002/3/EC of the European Parliament and of the Council relating to ozone in ambient air.

An existing Guideline (see the *Appendix II* of this Code) showcases some examples of experience in measures/programmes implementation and effectiveness assessment (Germany, Netherlands, Austria, France and Greece) for Short-Term Action Plan.

Figure 12 - Air quality measures, examples of Good Practice given in the Appendix V

Air Quality measures – Good Practice examples

Here in the following, is reported the list of the AQ measures examples showed as good practices in this publication (see Appendix V), divided by sector:

Transport

- ✓ Low Emission Zone - LEZ for trucks and cars, without individual exemptions (Berlin)
- ✓ Congestion Charge - Road pricing to enter central area on weekdays to reduce congestion (London)
- ✓ Toxicity Charge or T- Charge (London)
- ✓ Environmental bonus for buses cutting emissions (Helsinki)
- ✓ Cleaning public transport (Berlin)
- ✓ Buses retrofitting for NO_x (Copenhagen)
- ✓ Cycling networks, Cycling Highways (Copenhagen/Groningen/London)
- ✓ Parking discount for Low-emission Vehicles (Helsinki)
- ✓ Smart Solar Charging for electric cars (Utrecht)
- ✓ Intensive street cleaning and dust binding to reduce re-suspension (Helsinki)

Construction

- ✓ Non-Road Mobile Machinery Low Emission Zone - NRMM LEZ (London)
- ✓ Particle Filters eco-label for construction machinery (Berlin)

Heating Supply

- ✓ Ban of solid fuels for household heating (Kraków)
- ✓ District heating mandatory for new buildings (Upper Austria)

Citizens awareness

- ✓ Air quality Alert websites (London, UK)

This list is obviously not exhaustive in showing good practices, but can be source of inspiration for cities authorities to explore feasibility of some kind of measures in their own territory to improve local air quality.

AIR QUALITY MEASURES LOCAL GUIDELINE

Republic of Croatia

Local city guidelines recommend implementation and development of environmentally friendly transport systems in the territory of the City of Zagreb, or rather all forms of mobility with lowest emissions and the lowest energy consumption, promotion of clean best available technologies, energy efficient building in the public and private sector, energy saving and rationalization of consumption, ensuring conditions for modernisation and expansion of the city network of measuring stations for continuous air quality monitoring, etc.

Based on these guidelines individual measures and activities have been defined in air protection documents of the City of Zagreb by which, in a synergistic manner, sources and reduction of emissions of main pollutants, such as NO_2 and PM_{10} and $PM_{2,5}$ particles should be addressed.

Through reduction of particle emission from households and road transport also reduction in emissions of B(a)P expected to be achieved. For the reduction of ground-level ozone pollution, local measures for reduction of O_3 precursors (e.g. NO_x, VOC) are not sufficient, and action by the international community within the framework of CLRTAP[46] and the related Gothenburg protocol is required.

References:

- Annual reports on monitoring air quality in Croatia (national and local networks) 1999-2016: http://iszz.azo.hr/iskzl/godizvrpt.htm?pid=0&t=0

[46] CLRTAP - UNECE Convention on Long Transboundary Air Pollution https://www.unece.org/env/lrtap/welcome.html.html

MEASURES BY SECTOR

City of MADRID (Spain) [3 141 991 inhabitants]

New measures 2011-2015		
SECTORS		**MEASURES**
1	TRANSPORT AND MOBILITY SECTOR	42
2	RESIDENTIAL, COMMERCIAL AND INSTITUTIONAL SECTOR	4
3	CONSTRUCTION AND DEMOLITION WORK	2
4	CLEANING AND WASTE MANAGEMENT	4
5	URBAN PLANNING	4
6	NATURAL HERITAGE	2
7	STRENGTHENING INTEGRATION OF CONSIDERATIONS RELATIVE TO AIR QUALITY IN MUNICIPAL POLICIES	4
8	MONITORING, FORECASTING AND INFORMATION SYSTEMS	3
9	TRAINING, INFORMATION AND AWARENESS	5
TOTAL		70

References:

- Madrid's Air Quality Plan 2011-2015: https://www.madrid.es/UnidadesDescentralizadas/AreasUrbanas_EducacionAmbiental/Catalogo/AirQualityPlan2011-15.pdf

PACKAGES OF TRAFFIC MEASURES

City of BERLIN (Germany) [3 711 930 inhabitants]

Scope of the five-measure package for scenario calculations in the motor vehicle traffic area		
Abbreviation	**Package of measures**	**Measures included**
MB1	Improved vehicle technology	Environmental zone without individual exceptions Higher share of EURO-6 vehicles Support for electro-vehicles Retrofitting with particulate filters (EURO-4 cars/trucks) and NO_x scrubbers (EURO-4 trucks)
MB2	Optimization of traffic flow	Reduction of traffic backups by: Traffic-light coordination Inflow dosage 30 km/h speed limit
MB3	30 km/h speed limit at hotspots	Introduction of 30 km/h zones
MB4	Emissions reduction in the urban background	Ban on solid-fuel heating for housing Particulate filters for construction machines Retrofitting with particulate filters in passenger ships
MB5	Achieving the 2020 fleet early	Early compliance with regulations not mandatory until 2020

References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en

7.4 Assessing the effectiveness of measures

> ***Directive 2008/50/EC*** *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* ('Ambient Air Quality Directive' - AAQD): *Art. 23; Section A of Annex XV*
>
> ***Commission Implementing Decision 2011/850/EU*** *of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C (2011) 9068)* ('IPR Decision')

The Air Quality Directive requires to assess to what extent the measures included in the AQP would be effective in reaching compliance with the Air Quality Limit values or Target values within the defined time plan. In Section A of Annex XV point 8 (c) of AAQD is required:

> *8. Details of those measures or projects adopted with a view to reducing pollution following the entry in force of this Directive:*
>
> (a) Listing and description of all the measures set out in the project;
>
> (b) Timetable for implementation
>
> (c) **Estimate of the improvement of air quality planned and of the expected time required to attain these objectives**.

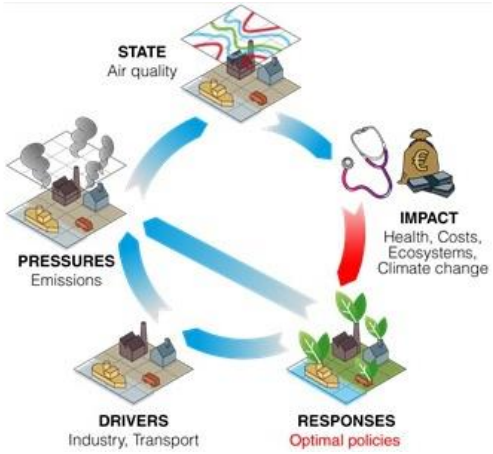
Legislation asks only for air quality improvement assessment, but it is a good practice to implement a Health Impact Assessment (HIA) and evaluate Climate change impact of the selected AQ measures.

Some scientific working groups provide analysis and methodologies to evaluate and test the robustness of models applied in assessment of AQ and scenario mode to assess the impacts of AQPs.

The Forum for Air quality Modelling in the European Union (FAIRMODE)[47] is developing guidelines for models to be used for estimating which sources contribute to urban air quality (Source Apportionment) and to calculate the effectiveness of reducing emissions from certain sources.

[47] FAIRMODE Group http://fairmode.jrc.ec.europa.eu/

Figure 13 - The DPSIR Framework Concept, adopted by EEA, applied to Air Quality in FP7 Appraisal Project[48] to explain the effectiveness of measures (Responses) assessment performed in an AQP.



Source: Appraisal FP7 Project Layman's report

7.4.1 Air Quality impacts

For each measure, or group of measures, included in the Air Quality Plan, estimates of the impact on air quality have to be produced using modelling with the appropriate degree of detail.

The input data for this AQ modelling are emissions (see next Box below) and meteorological data/model results assessed at the proper scale. The objective is to evaluate how emission changes reflect on concentration change in 1) different future scenarios with implementation of AQP measures, referring to 2) a baseline scenario, that usually is related to 'business as usual' (BAU) emission projections or to scenarios that include effects of already planned measures, not related to the AQP. In this way one can reply to these questions:

- ✓ What happens to emissions and concentrations, when no extra local measures are taken?
- ✓ What will be the future 'distance to target' (the gap between projected concentrations and the air quality limit values or population exposure targets, e.g. the WHO Guidelines)?
- ✓ How many micrograms per cubic meter should be reduced at hot spots or for the average population exposure in a city or neighbourhood?

For estimating the impact of emission reductions, due to the selected possible measures of the AQP, on local concentrations, different tools can be used.

For NO_2, the simplest approach is to assume a linear relationship between the emission reduction from a certain source and the reduced contribution from that source to the average concentration in a city, neighbourhood or street. For the impact on the city level and street increment more advanced 'gaussian' and 'street canyon' models can be applied. Such models assume certain mixing parameters that take into account traffic density, the shape of the street and the presence of trees (trees could lead to an

[48] APPRAISAL FP7 Project, http://appraisal-fp7.terraria.com/site/index.php

accumulation of pollution under the tree crown). Some models take into account the chemical process that converts NO-emissions into NO_2-concentrations. To assess the impact of measures on the city background level, more complex atmospheric models will be needed that include meteorology and chemical reactions, such as the formation of secondary particles or ozone. These models are the Chemical Transport Models, which can be used for urban background pollution estimation.

For PM_{10} (and $PM_{2.5}$), modelling can be more complex, because the contribution of local sources (such as traffic) can be substantially less than for NO_2. Traffic contributes to primary PM-emissions via abrasion of tyres, brakes and roads, and via tailpipe emissions of soot (the latter contribution is rapidly declining due to the introduction of the diesel particle filter - DPF). The contribution from domestic burning of wood or other solid fuels is significant in some cities. In regions with high densities of traffic, industry and livestock, secondary particles (ammonium-nitrate, ammonium-sulphate) create a 'blanket' of high $PM_{2.5}$ concentrations over a large area, which diminishes the possibility of city authorities to substantially reduce $PM_{2.5}$ concentrations. For the assessment of the reduction of PM_{10} or $PM_{2.5}$ concentrations it is important to take sources outside the city and the formation of secondary particles into account. In this case, the use of the Chemical Transport Model is suggested (also regional applications of the EMEP-model, the CHIMERE model and the Lotos-Euros-model could be considered). Alternative approaches are available, such as RIAT+[49] and SHERPA[50].

Results of the AQ modelling are the bases of the Health Impact Assessment (*Section 7.4.2*). They can help improve the selection and prioritizing measures (see *Section 7.5*) and increase the impact in communicating the AQP.

See in next boxes examples of good practices implemented in several cities for assessing impact of measures in term of emission and concentrations at city/street level.

Impact of Climate Change on Air Quality future scenarios

Climate change in many EU areas is making worse air pollution problems, by means of changing in synoptic circulation that can strongly affect local weather with not so positive future scenarios: reduced yearly amount of precipitations, increasing heat waves in summer and stagnant atmosphere periods in winter. All these phenomena would have changes in frequency, duration and intensity with consequence that in general means higher concentration levels of ground level Ozone in summer or higher trapping of pollutants during stagnant or dry periods. These factors have to be considered by appropriate modelling tools during the assessment for effectiveness of AQ Plan measures in future scenarios. Obviously, it would be a good practice to consider the worst global climate scenario following the precautionary principle and referring to the official reports of the Intergovernmental Panel on Climate Change (IPCC)[51].

[49] RIAT+ http://www.riatplus.eu/html/eng/home.html

[50] SHERPA tool: http://aqm.jrc.ec.europa.eu/sherpa.aspx

[51] Climate Change 2014. Mitigation of Climate Change. Working Group III - Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, http://www.ipcc.ch/report/ar5/wg3/

AIR QUALITY IMPACT (Emissions)

City of BERLIN (Germany) [3 711 930 inhabitants]

Emission reduction for different group of measures scenarios for vehicular traffic (see description *Section 7.3.2*)

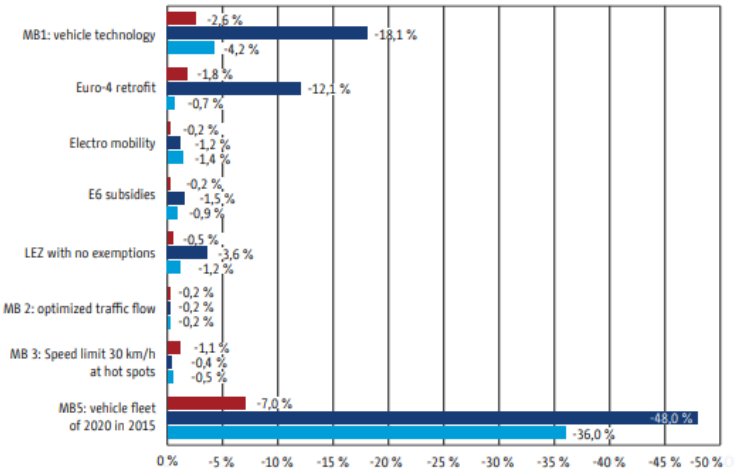


Figure 8.1: The effect of various measures on motor vehicle emissions in Berlin, compared to the trend scenario modelled for 2015

Emission reduction for different measures scenarios for no-traffic sources

Measure	Particle reduction
Ban of solid fuels for small combustion plants and additional heating	407 t/a
Particulate filters for construction machines	105 t/a
Retrofitting with particulate filters for passenger ships	0,5 t/a

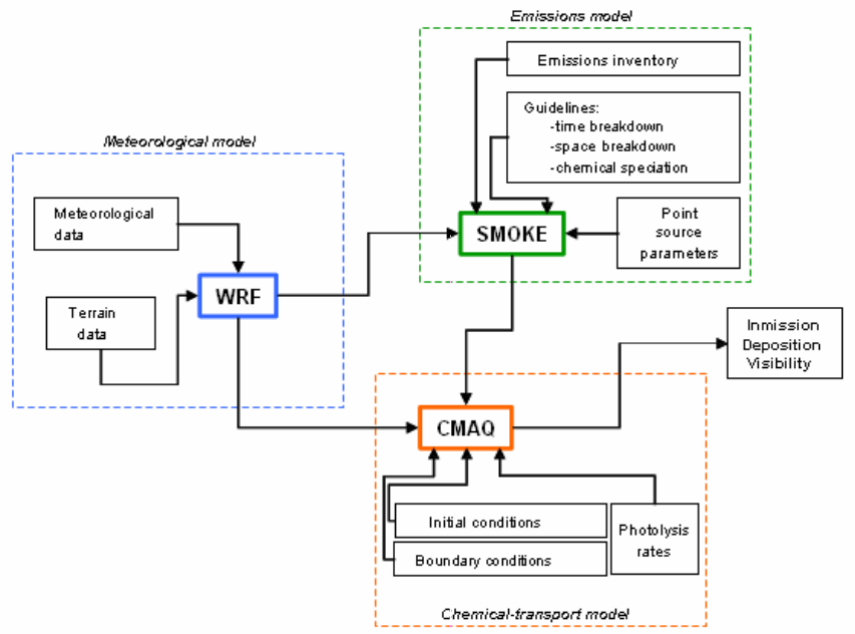
References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

AIR QUALITY DISPERSION MODELS

City of MADRID (Spain) [3 141 991 inhabitants]

Scheme of the Chemical Transport Model (CTM) used for City of Madrid's AQP

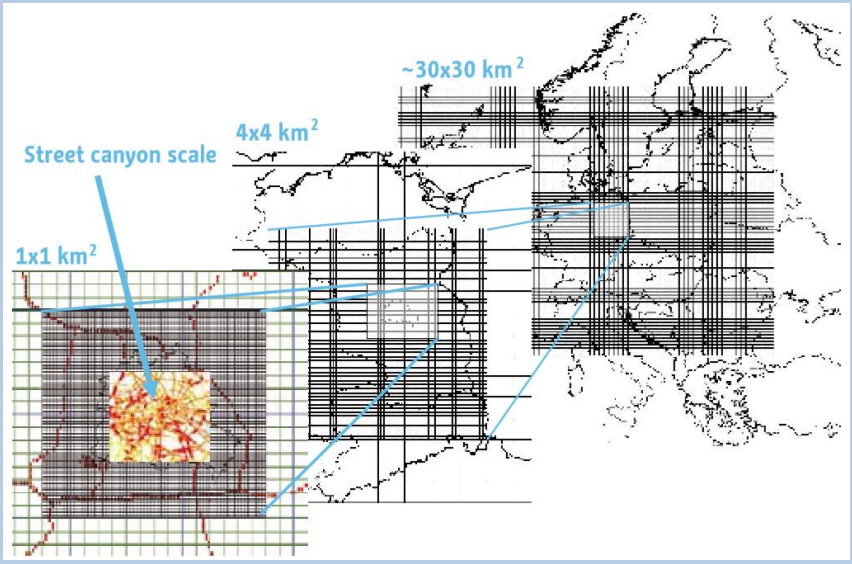


References: Madrid's Air Quality Plan 2011-2015, https://www.madrid.es/UnidadesDescentralizadas/AreasUrbanas_EducacionAmbiental/Catalogo/AirQualityPlan2011-15.pdf

AIR QUALITY DISPERSION MODEL SCHEME

City of BERLIN (Germany) [3 711 930 inhabitants]

Air quality dispersion model nesting: spatial distribution and resolution used for AQ planning in Berlin

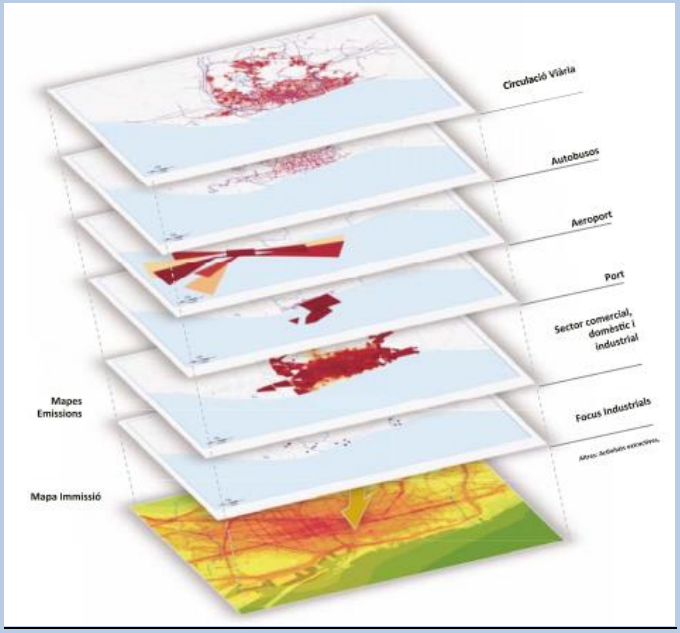


References: Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en

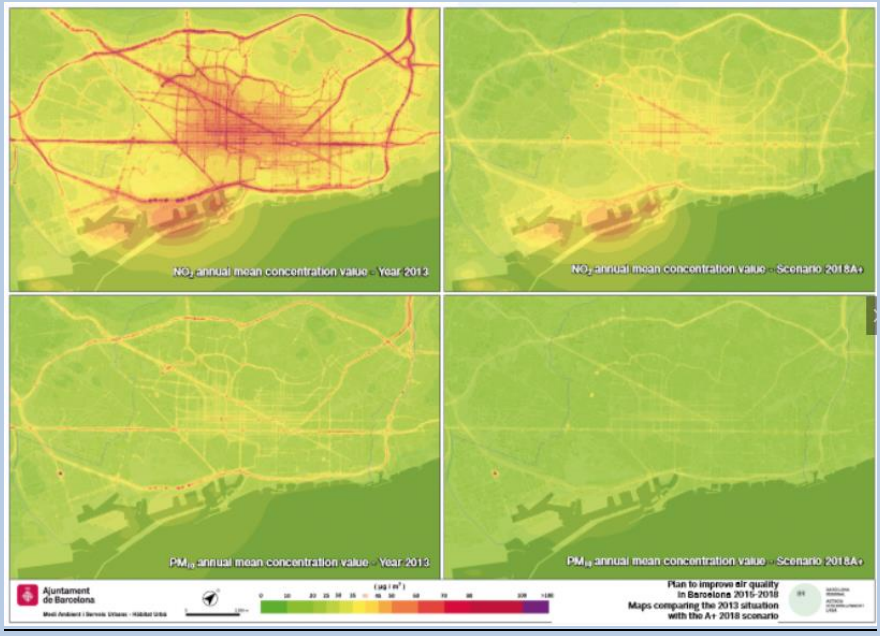
AIR QUALITY SCENARIOS MAPS

City of BARCELONA (Spain) [1 620 809 inhabitants]

Different Emissions sources maps considered as input for Air Quality scenarios maps



Air Quality scenarios for NO_2 and PM_{10} concentrations: base case (left) and AQP scenario (right)



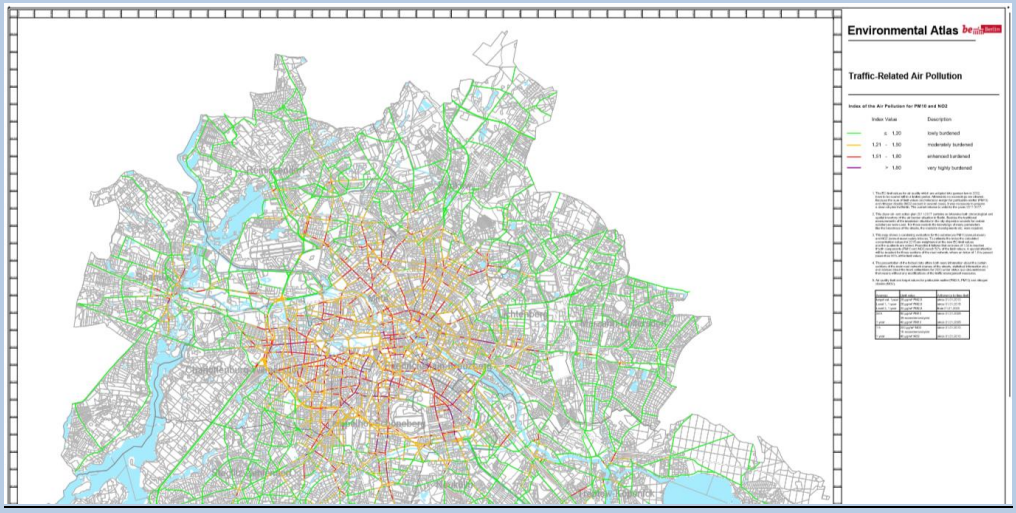
References:

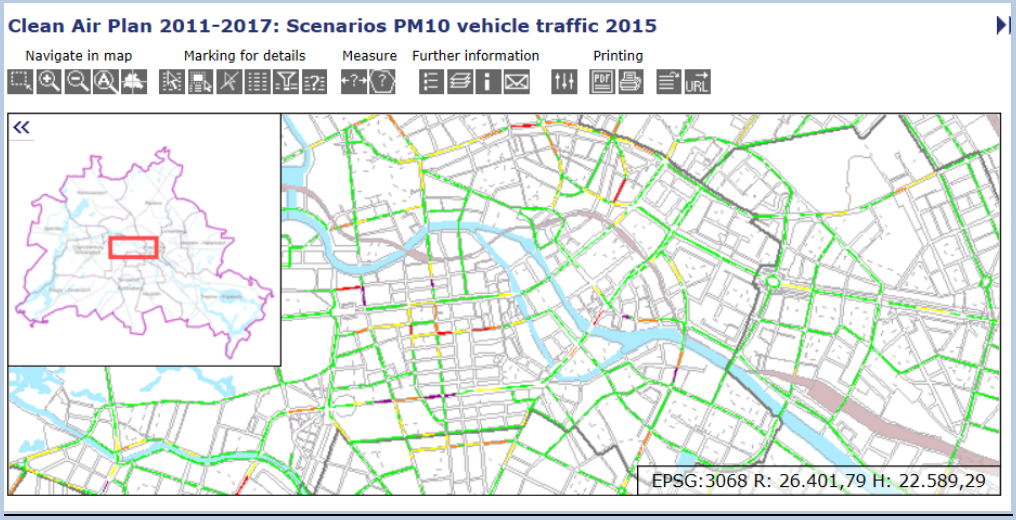
- Plan to improve air quality in Barcelona 2015-2018, https://ajuntament.barcelona.cat/qualitataire/sites/default/files/pdfs/PMQAB_EN_2014.pdf

AIR QUALITY IMPACT MAPS

City of BERLIN (Germany) [3 711 930 inhabitants]

In Berlin AQP the effect on the individual road sections is shown in the Environmental Atlas [Umweltatlas] under the topic Air [Luft]:
http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/dinh_03.htm





References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

7.4.2 Health impacts

To assess the health benefit of the possible measures and help prioritizing, making a Health Impact Assessment (HIA) during the elaboration of the AQP is a good practice.
The HIA is also useful to create acceptance of interventions that are being experienced to be 'inconvenient' for some citizens, such as Low Emission Zones (LEZ), biomass burning restrictions or new building area rules. Using HIA tools, and thus being able to communicate the public health risks associated with different scenarios, raises public awareness with scientific evidence.

In order to make HIA approachable several tools or models have been developed. Input data of HIA tools are:

1. Concentration levels of air pollutants
2. Exposed population and its characteristics
3. Health outcome baseline incidences.

The first step of a HIA is to **estimate the exposure of the target population**. A combination of air quality monitoring data and air quality modelling is often used to estimate the exposure for a population and to predict changes in exposure in different policy scenarios.

The second step is to **estimate the health risk associated with the exposure to air pollution**. This requires Concentrations-Response Functions (CRF) defined with scientific evidence in epidemiological studies that are locally dependent. Results of HIA are usually reported in terms of mortality (e.g. number of premature deaths, change in life expectancy or the number of life years lost -YLL) and morbidity (e.g. asthma, lung cancer, working days lost, etc.) on short term and long term. Morbidity and mortality effects can be aggregated into the loss of Disability Adjusted Life Years (DALY).
The third step is to **quantify and express the uncertainty of the estimated health impact**.

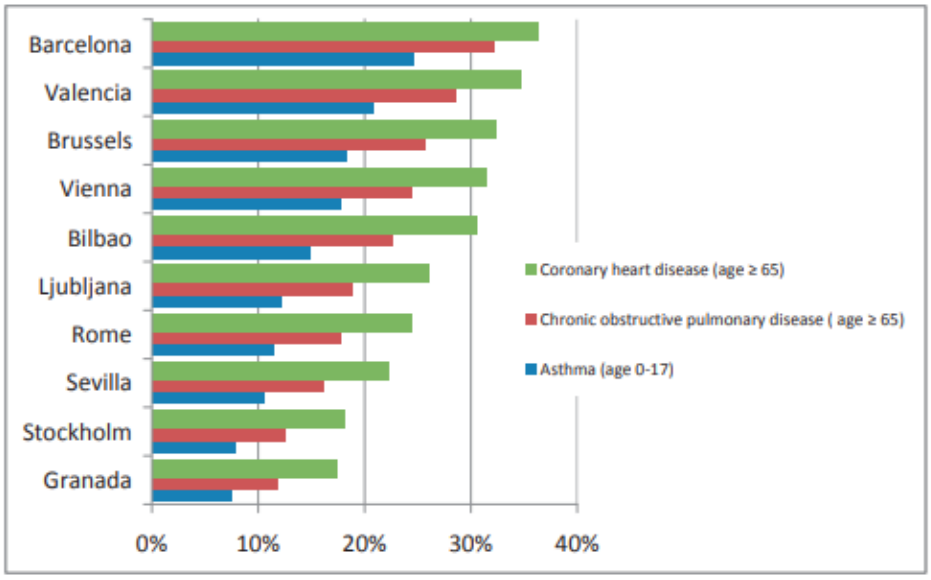
In the following, three different levels of complexity for quantifying the health impact of air pollution are showed; spatial resolution is a factor to be considered when selecting the approach:

1. It is possible to make reference to the **AirQ+ tool**, which is developed by the WHO Regional Office for Europe. It can handle the following pollutants: $PM_{2.5}$, PM_{10}, NO_2, O_3 and black carbon (BC). AirQ+ includes methodologies to assess the effects of long-term and short-term exposure to ambient air pollution. Various health outcomes related to mortality and morbidity, both in terms of acute and chronic conditions can be considered for the calculations. Health outcomes are expressed as: attributable proportion of cases, number of attributable cases, number of attributable cases per 100.000 population at risk,

proportion of cases in each category of air pollutant, and cumulative distribution by air pollutant concentration, Years of Life Lost (YLL).

2. This level can be represented by the tool developed by the Public Health Services of Amsterdam and Arnhem (Zuurbier *et al.*, 2014) based on relative risks from the **WHO-HRAPIE** Report (2013) (minimum population size 50,000). This tool can handle the following pollutants: PM_{10}, $PM_{2.5}$, NO_2 and Elemental Carbon (EC). Health outcomes are expressed as: YLL due to mortality (Miller and Hurley, 2006), Hospital admission and DALY's. Estimated YLL and Hospital admission can be calculated per subject or in an easier method for the whole population. However, estimated health effects per person take into account the distribution of exposure within the population**.**
3. This level can be represented by the approach used in the **APHEKOM Project**[52] *(Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe*), that performed a HIA in 25 EU cities. In the cities studied, Aphekom HIA approach showed that living near busy roads (> 10,000 or more vehicles per day) could be responsible for some 15-30 percent of all new cases of asthma in children; and of COPD (chronic obstructive pulmonary disease) and CHD (coronary heart disease) in adults 65 years of age and older (Figure 14).

Figure 14 - Percentage of population with chronic diseases whose disease could be attributed to living near busy streets and roads in 10 APHEKOM project cities



Source: APHEKOM, 2012

In order to perform a cost-benefit analysis of measures (see *Section 7.5*) a monetary evaluation of health impacts (expressed in euros) is needed. Elements for this evaluation

[52] APHEKOM (Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe), www.aphekom.org

can be derived from European studies (such as the ExternE-study)[53] and corrected for differences GDP per capita in a country (or city).

The Partnership of Air Quality developed a tool 'PAQ2018' which can be used by European cities to estimate health effects from air pollution in their cities[54]. This tool is a combination of two existing tools namely AirQ+ (developed by the WHO) and the tool developed by the Public Health Services of Amsterdam and Arnhem (GGD tool). The strengths of these tools have been combined in order to make HIA approachable for municipalities of European cities in particular.

The strengths of this tool are the pragmatic usability, its rich model output and its capability of conducting many analyses at once after which all the results become visible at a glance. Compared to the AirQ+ and GGD tool, the output has been extended with DALYs and a monetary value of the health impact. Besides, with the PAQ2018 tool it is possible to calculate the health profit or loss of two different pollution scenarios.

Box 7 - HIA tool developed by the Partnership on Air Quality

Health Impact Assessment tool (PAQ 2018) and Report

The Partnership Air Quality, in cooperation with City and University of Utrecht, in the framework of Action 4 (Better Focus on the Protection and on the Improvement of Citizens' Health) developed, after an analysis of existent ones, a new tool for HIA:

- PAQ 2018.

This tool (spreadsheet), is available, together with instruction for use, on the Futurium Platform: *https://ec.europa.eu/futurium/en/air-quality*

A Report titled

- '*The use of Health Impact Assessment tools in European cities*' (Van de Brenk, 2018)

is the result of the performed analysis of existent tools and presentation of the PAQ2018.

[53] ExternE: http://www.externe.info/externe_d7/

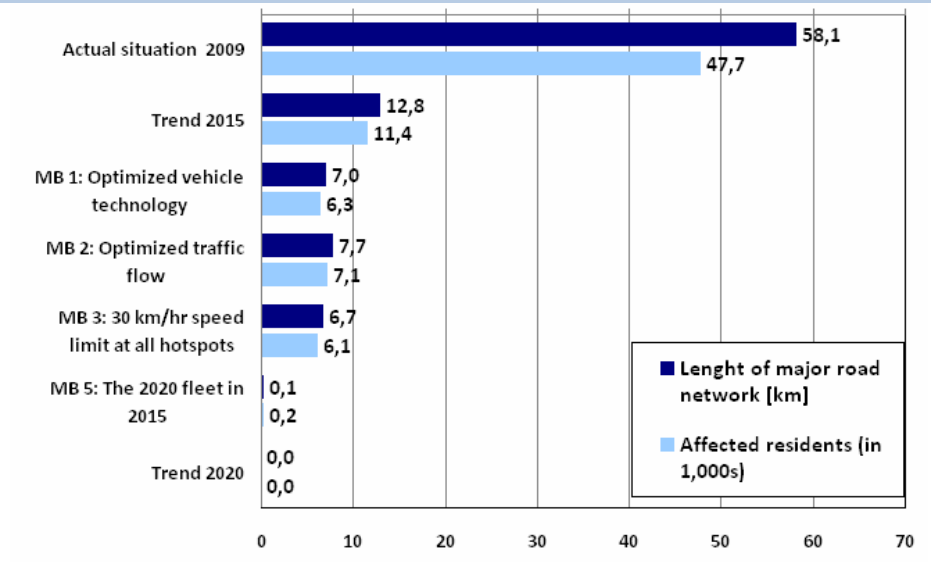
[54] Van den Brenk, I., 2018: The Use of Health Assessment Impact Tools in European cities. A guide to support policy towards cleaner air and improvement of citizens' health. Urban Agenda - Partnership on Air Quality, Action 4 Deliverable, November 2018

AIR QUALITY IMPACT ON POPULATION

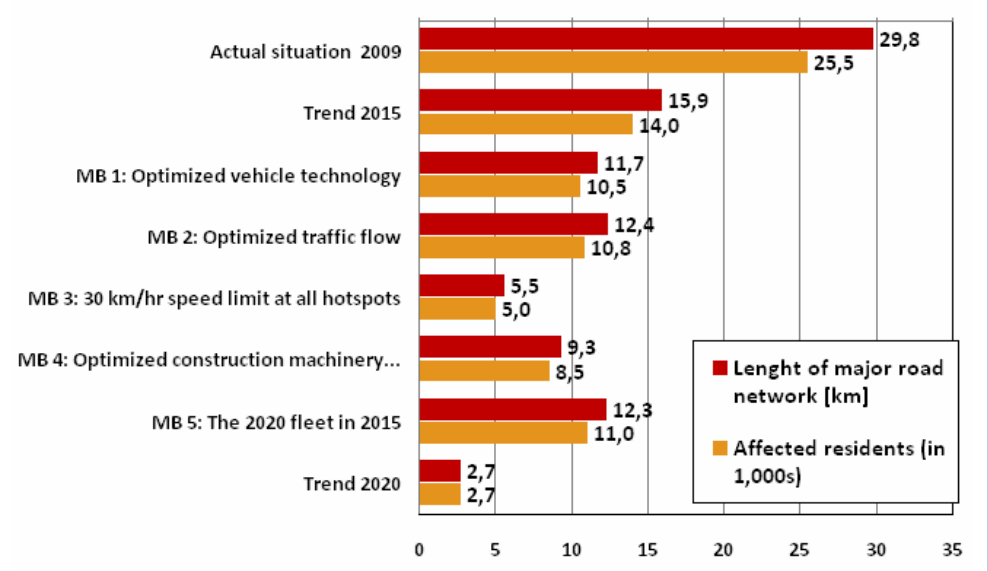
City of BERLIN (Germany) [3 711 930 inhabitants]

Air Quality scenarios for PM_{10} and NO_2 concentrations in term of length of road segments and number of residents affected by exceeding limits levels in the trend development and given implementation of the package of measures for 2015 (see description on *Section 7.3.2*).

NO_2



PM_{10}



The Figures above are derived by modelling at streets levels for NO_2, PM_{10} and Soot concentrations.

References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

AIR QUALITY IMPACT ON POPULATION

City of UTRECHT (The Netherlands) [344 384 inhabitants]

In the following example of use of **WHO - Air Q+ tool** to assess the health impact of air pollution on a concept city of 300.000 citizens and 100 km^2 in the Netherlands is reported. The question to be addressed is: *how many deaths are attributable to long-term exposure to different ambient levels of $PM_{2.5}$?*

Impact Evaluation Long-term effects of Ambient Air Pollution ($PM_{2.5}$)

City of 300.000 citizens,

Cut-off value = 5 µg/m^3	**Ambient levels $PM_{2.5}$**			
Mortality, all (natural) causes (adults age 30+ years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	2.96	5.84	8.63	11.34
Estimated # of Attributable Cases	90	176	261	343
Estimated # of Attributable Cases per 100 000	45.93	90.49	133.73	175.70
Mortality due to acute lower respiratory infection for children (0-5 years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	1.96	6.54	10.71	15.25
Estimated # of Attributable Cases	0	0	0	0
Estimated # of Attributable Cases per 100 000	0.00	0.01	0.01	0.02
Mortality due to COPD for adults (30+ years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	2.91	6.54	9.09	10.71
Estimated # of Attributable Cases	3	7	10	11
Estimated # of Attributable Cases per 100 000	1.57	3.52	4.89	5.76
Mortality due to lung cancer for adults (30+ years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	3.85	8.26	10.71	13.79
Estimated # of Attributable Cases	3	7	9	12
Estimated # of Attributable Cases per 100 000	1.67	3.58	4.65	5.99
Mortality due to ischemic heart disease for adults (25+ years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	30.07	41.18	47.09	51.22
Estimated # of Attributable Cases	53	73	83	90
Estimated # of Attributable Cases per 100 000	24.87	34.05	38.94	42.36
Mortality due to Stroke for adults (25+ years)				
	10 µg/m^3	**15 µg/m^3**	**20 µg/m^3**	**25 µg/m^3**
Estimated Attributable Proportion	17.36	31.51	41.18	48.45
Estimated # of Attributable Cases	22	40	52	61
Estimated # of Attributable Cases per 100 000	10.27	18.65	24.38	28.68

Source: City of Utrecht, University of Utrecht, 2018

7.4.3 Climate change impact

Co-benefit of Air Quality measures on Climate Change mitigation policies

The reduction of ambient concentration of several pollutants due to measures adopted in an AQP can not only have a positive effect at local level in terms of human health, but also contribute to tackle climate change issues thus achieving important co-benefits at global level.
Any AQ measure focused on **reduction or ban in use of fossil fuels has a positive impact for reduction of CO_2 emissions** and thus brings benefits also in terms of addressing the climate change challenge (e.g. Electric or hybrid vehicles or engines).

In particular, in the case of AQ measures focused on the reduction of emissions of **Black Carbon (BC), methane (CH_4),** and **hydrofluorocarbons (HFCs),** or of measures to reduce **Ozone (O_3)** - and its precursors - four atmospheric compounds classified '***Short-Lived Climate Forcer***' **(SLCF)**, it is possible to obtain additionally an important positive effect in terms of climate change mitigation. In fact, these ambient air pollutants, with a huge climate forcing impact, have a shorter lifetime in atmosphere than CO_2 (that is hundreds of years) and their emissions reduction can reduce total climate concentrations and global temperatures faster and in a more significant manner, than acting only on reducing CO_2 emissions.

Acting locally on the reduction of these pollutants it is possible to obtain a **'win-win strategy'**[55] (on local health and on global climate) and also achieve cost saving. Thus in the framework of the assessments performed in the elaboration phase of the AQ plan it is a good practice to add assessment related to the benefits reachable in term reduction of greenhouse emissions, not only in term on CO_2 but also in term of these 'short-lived climate forcers', in particular for those with a Global Warming Potential (GWP) index higher than CO_2 (around 680 times for Black Carbon[56] on a 100 years basis and 28-26 times for Methane[57]).

It is clear that an 'integrated' planning on air quality and climate change would be a good practice for a city engaged in sustainable goals.

Climate Change Policies need coherence with Air Quality Plans

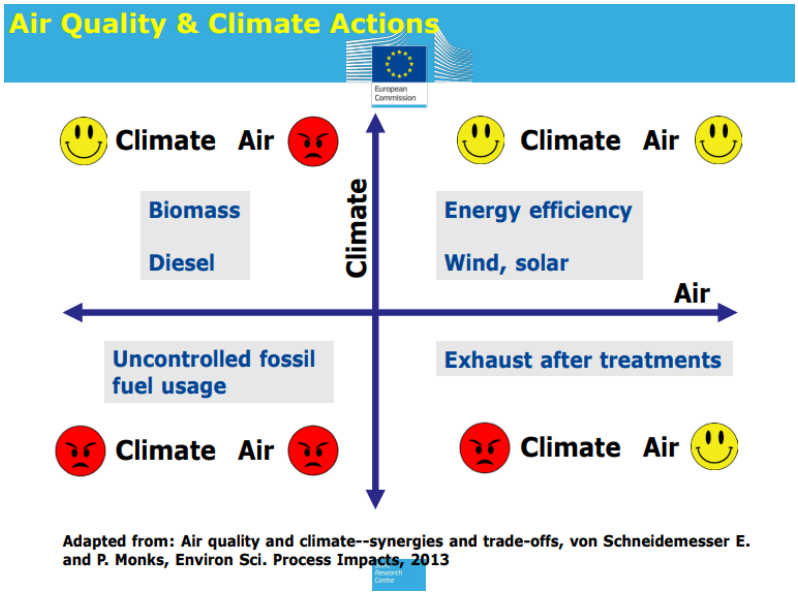
If an Air Quality measure generally has a co-benefit for climate change policies, climate change mitigation actions not always bring positive effects on air quality.

It is the case of the increase in the vehicle fleet of diesel motorization (based on lower CO_2 emission factors, but with higher emissions of PM and NO_2) and the use of biomass burning, with toxic emissions of PM and benzo(a)pyrene as main pollutants (Figure 15).

[55] Shindell et al., 2012: 'Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security', Science 2012; 335: 183-189.
Anenberg et al., 2012: 'Global Air Quality and Health Co-Benefits of Mitigating Near-Term Climate Change through Methane and Black Carbon Emission Controls', Environ Health Perspect. 2012 Jun;120(6):831-9. doi: 10.1289/ehp.1104301. Epub 2012 Mar 14.
[56] Bond and Sun, 2005: 'Can reducing black carbon emissions counteract global warming?', Environ Sci Technol. 2005, Aug 15;39(16):5921-6 https://www.ncbi.nlm.nih.gov/pubmed/16173547
[57] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#Learn%20why

Another air quality problem not faced by Climate Action Plans, that usually contain incentives for electric vehicles, is the non-exhaust emissions from those vehicles (PM, metal oxides, etc.).

Figure 15 - Air quality and Climate Change challenge in measures selection[58]



Source: Vignati et al., 2018

Examples of win-win strategies

Examples of measures co-benefitting air quality and climate are:

- ✓ Reduction/ban of fossil fuels use (both fixed sources and traffic) with promotion of renewable energy source (not including biomass burning): solar, wind energy, etc.;
- ✓ Implementation of energy efficiency policies.

At city level, local administration can act also at micro-scale planning level, for instance, with:

- ✓ the creation of wider green areas;
- ✓ the redefinition of urban density in new development areas, with creation open corridor to improve air pollution dispersion.

These solutions can bring benefits on the temperature levels at micro-scale, reducing damage linked to heat waves or tropical nights at urban level.

In conclusion, it is important to bring higher on the urban agenda the concept of 'integrated sustainable planning' that requires strong coherence between Climate Change Plans and Air Quality Plans together with dialogue and coordination between authorities involved and the public.

[58] Vignati et al., 2018: 'Air Quality in Europe: Overview, Issues and way forward', EU Greenweek Proceedings, May 2018

7.5 Selecting and prioritizing measures

In order to define Responses (that means, to select which policies should be implemented), the main available approaches are based on:

- **Scenario analysis**: in this context, in the ideal case, the selected policies will be 'translated' in emission change and then in concentration change, using a multiscale approach based on what we discussed in the previous sections (using different models able to describe how the measures will impact a) urban background, b) city level pollution and c) street canyons);

- **Optimization approaches**: in this case the idea is to look for the optimal (best) compromises between air quality improvement and costs of policies.

  Integrated Assessment Models are fit-for-purpose tools to do so (as i.e. GAINS, Amann *et al*., 2011 or RIAT+, Carnevale *et al*., 2012).

A key aspect for both approaches (scenario or optimization) is to have reliable inventories of emission reduction measures. Several inventories have been made of measures to improve air quality at local scale. Often they are focused at finding a solution to solve exceedances at certain hotspots (see e.g. the JRC catalogue of measures, at http://fairmode.jrc.ec.europa.eu/measure-catalogue/, or the JOAQUIN Decision Support Tool, at http://www.joaquin.eu/Knowledge/Decision-Support-Tool/page.aspx/121).

If considering the mobility sector as an example, we can say that reducing traffic has a greater effect on population exposure than a shift to zero-emissions vehicles (because emissions from tyres, break and road wear will still continue). Stimulating zero-emission vehicles is more effective than a shift from diesel to petrol cars. The effectiveness of low emission zones depends largely on the size of the zone.

In assessing the health impacts, one should realize that concentration reductions also occur outside the city, because cities are a net exporter of pollution and because measures will also cause a shift in vehicle types and modal split in the commuting zone around the city.

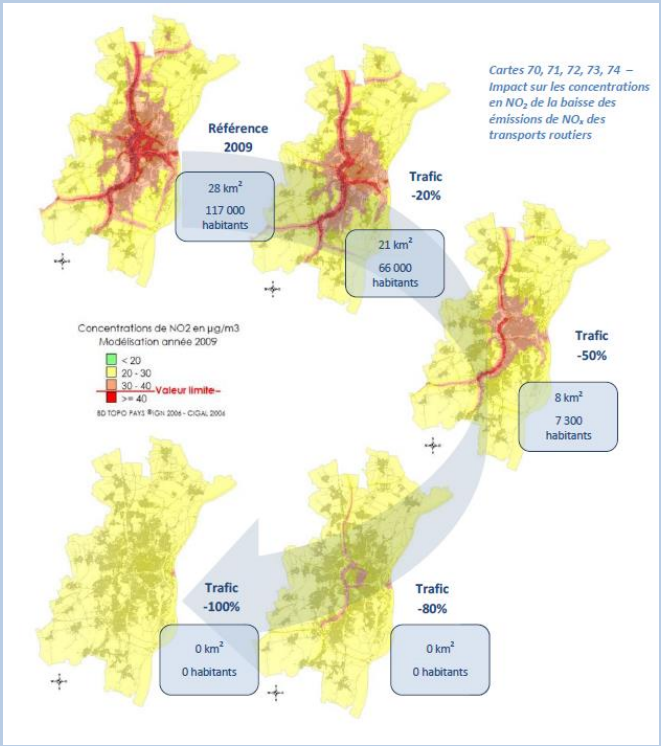
The implementation of measures depends on the public and political awareness and support, the choice of policy instruments (promotion campaigns, use of economic instruments, regulation and/or infrastructural investments) and the available funding.
The effectiveness of local measures for the average $PM_{2.5}$ exposure in a city is often limited, because a substantial part of the air quality is influenced by sources outside the city. Local measures on traffic can be more effective on NO_2 concentrations.

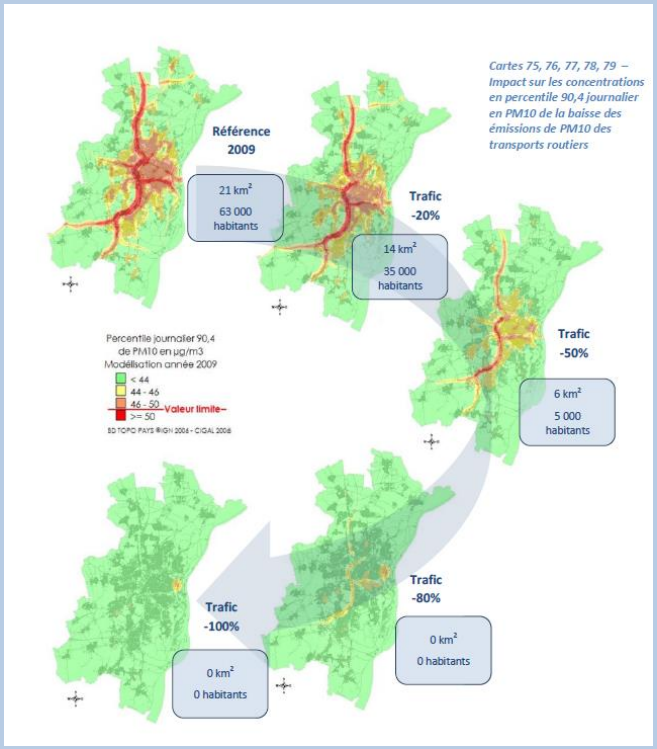
AIR QUALITY SCENARIOS ANALYSIS

STRASBOURG Agglomeration (France) [470 000 inhabitants]

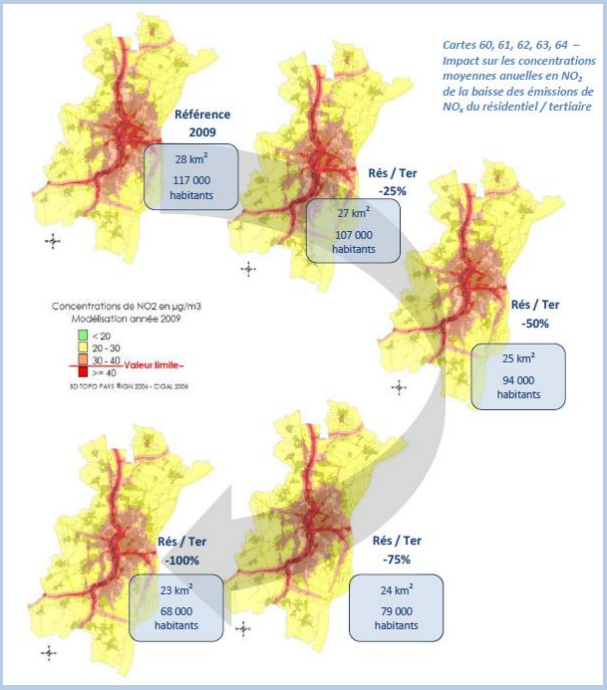
Plan de Protection de l'Atmosphère de l'Agglomeration Strasbourgeoise, 2015-2020

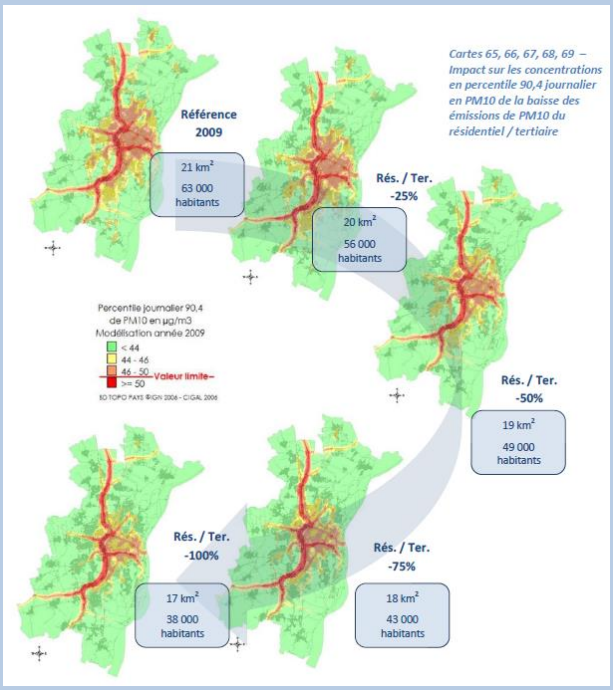
Impact on Air quality of Traffic measures:





Impact on Air quality of Residential/tertiary heating suppling measures:





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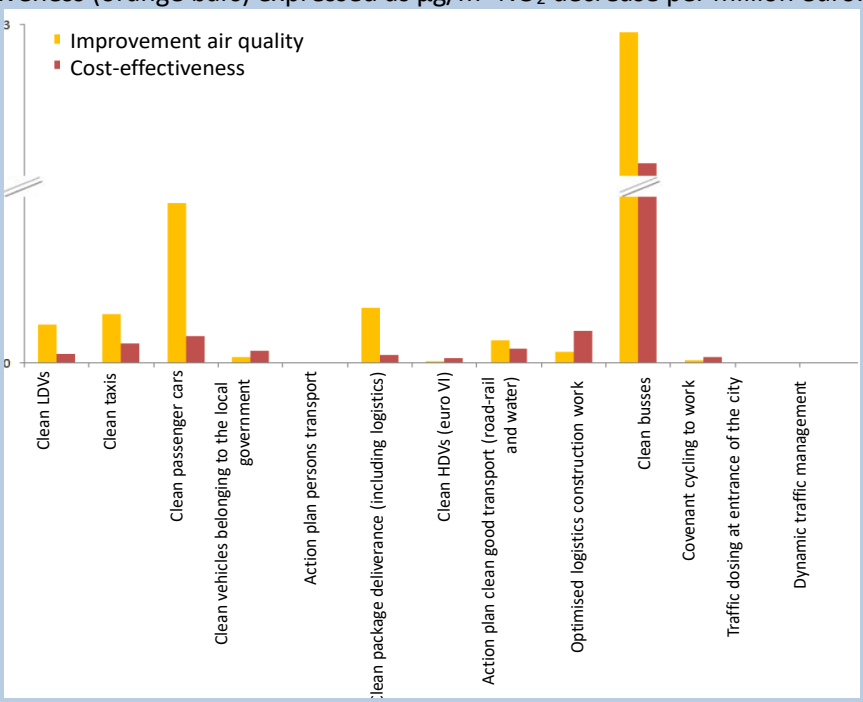
- Plan de Protection de l'Atmosphère de l'agglomeration strasbourgeoise, 2015-2020 http://www.bas-rhin.gouv.fr/Politiques-publiques/Environnement-prevention-des-risques-naturels-et-technologiques/Air/Plan-de-Protection-de-l-Atmosphere-de-l-agglomeration-strasbourgeoise-PPA

COST EFFECTIVENESS

City of UTRECHT (The Netherlands) [344 384 inhabitants]

Assessment of effectiveness of AQ measures, Utrecht AQP 2013-2015

Effect of measures on the improvement of air quality (yellow bars) and their cost-effectiveness (orange bars) expressed as µg/m^3 NO_2 decrease per million euro.



The conclusion is that clean busses have the highest effect, followed by stimulating clean passenger cars, package deliverance, clean taxis and clean LDVs. Most of the total expenditures is invested in clean busses.

Table: Measures in order of cost-effectiveness

Nr Measure	Cost Effectiveness (in µg/m^3 NO_2 decrease per million euro)
1. Clean busses	1.59
2. Optimised logistics construction work	0.20
3. Clean passenger cars	0.17
4. Clean taxis	0.12
5. Action plan clean good transport (road-rail-water)	0.09
6. Clean vehicles belonging to the local government	0.08
7. Clean LDVs	0.06
8. Clean package deliverance (including logistics)	0.05
9. Covenant cycling to work	0.04
10. Clean HDVs (euro VI)	0.03
11. Traffic dosing at entrance of the city	-
12. Dynamic traffic management	-
13. Action plan persons transport	-

References:

- Community of Utrecht, 2013. Gezonde lucht voor Utrecht, Uitvoeringsprogramma 2013-2015. https://www.publicspaceinfo.nl/media/uploads/files/UTRECHT_2013_0012.pdf

7.6 Listing and describing the measures selected

The final section of the AQP is generally dedicated to listing and describing the measures selected.

In the following tables some examples of presentation of measures are given. In tables the measures can be listed together with a synthetic description of assessed impact for targeted pollutants and other benefits, the timing for implementation and related responsible authority. For each measure a one/two pages description is given to better illustrate it with more details. For enhanced completeness and transparency, several AQPs also report the budget defined for implementing the AQP with the related time plan. This is a best practice increasing the chances for a successful AQP implementation.

LIST OF MEASURES

City of BERLIN (Germany) [3 711 930 inhabitants]

City of Berlin List of Measure, AQP 2011-2017

No.	Measure	Impact ↺ = spatial ☝ = on air quality: 0 = low + = medium ++ = high	Implementation and entry into force	Responsibility
Measures regarding planning instruments				
M 1.1	Land-use planning with due allowance for urban climatology and air exchange	↺ local to citywide ☝ +/++	long-term	Senate Department for Urban Development and the Environment [SenStadtUm] boroughs
M 1.2	Avoid new pollution hotspots	↺ local ☝ ++	long-term	SenStadtUm Boroughs
M 1.3	Greening of streets	↺ citywide ☝ +	long-term	SenStadtUm Boroughs
M 1.4	Pollution-sensitive development of sites of the Urban Development Plan on Industry and Business	↺ local ☝ 0/++	long-term	SenStadtUm Boroughs SenWiTechForsch
M 1.5	Urban Development Plan for city centres	↺ local ☝ 0/+	long-term	Boroughs SenStadtUm SenWiTechForsch
M 1.6	Traffic reducing spatial development	↺ citywide ☝ +	long-term	SenStadtUm Boroughs
M 1.7	Participation in urban land-use planning and planning permission procedures	↺ boroughwide ☝ 0/++	long-term	Boroughs (TÖB)
Measures Vehicle Technology				
M 2.1	Low emission zone without individual exemptions	↺ citywide ☝ +	until 2015	SenStadtUm
M 2.2	Promotion of EURO 6 vehicles	↺ citywide ☝ +	until 2015/16	SenStadtUm Federal Government
M 2.3	Promotion of natural gas vehicles	↺ citywide ☝ limited	ongoing	SenStadtUm Federal Government GASAG
M 2.4	Electric vehicle network	↺ citywide ☝ uncertain	medium- to long-term	SenStadtUm SenWiTechForsch Federal Government Boroughs

References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

MEASURES DESCRIPTION

City of BERLIN (Germany) [3 711 930 inhabitants]

M 4.1 Particle filter for construction machines

Timetable for implementation from 2012 ongoing	**Competent authority** SenStadtUm, public procurement agency issuing the tender
Potential for reduction • Reduction of approx. 100 t/a diesel soot • Local and city-wide effects	**Costs** approx. 1,000 to 15,000 € per construction machine

Engines of construction machines often cause high emissions of certain pollutants since the exhaust emission standards for these machines are much less stringent than for normal road vehicles. On a local level, construction machines may thus lead to increased pollution levels, particularly because some machines on construction sites run continuously for many hours. In sum, diesel soot emissions from construction machines (with 140 t/a) almost reach the emission level from road traffic in Berlin. This is because an emission reduction of almost 60 % was achieved in the road transport sector through the low emission zone. Since mobile devices and machines as well as self-propelled working machines are excluded from traffic bans within low emissions zones according to 35th BImSchV, there is no possibility of enforcing an emission reduction of construction machines by means of a low emission zone. However, almost all construction machines of more than 19 kW from the construction year 2000 are retrofittable as shown by the example of Switzerland. Switzerland introduced a nation-wide obligation to retrofit construction machines.

Objective of the measure:
Retrofit construction machines with particle filters in order to reduce particle emissions from this source group by 75 % by 2015.

M 2.25 Redistribution of public road space

Timetable for implementation	**Competent authority** SenStadtUm, Boroughs
Potential for reduction locally 5 to 10 % of the incremental pollution	**Costs** • approx. 50,000 € and more per section for construction works • approx. 10,000 € per section for modelling

The action strategy of redistributing public roads originates from the Noise Reduction Plan Berlin[111]. It intends for the start to extend the distance between road traffic and the housing on roads by up to 3 m, in order that the vehicle emissions can be better diluted until they reach the housing. Additionally, this generates more space for the non-motorised transport and where applicable for the local public passenger transport (bus line) and thus increases the attractiveness of the means of transport provided by ecomodes. Qualified are roads with multiple lanes that can also handle the traffic volume with a lesser number of lanes that are concentrated in the middle of the street canyon. The redistribution of roads is also possible on locations where traffics can be relocated by newly constructing main road connections (e.g. after extension of the urban motorway A100). The limit of the possible traffic performance in case of extending a four-lane road to a two-lane road (with an extra wide lane each direction) amounts to approximately 18,000 to 20,000 vehicles per day.

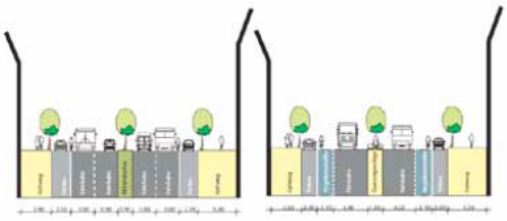


Figure 9.1: Brandenburgische Straße, Hohenzollerndamm to Berliner Straße: the left side shows the spatial road distribution before implementing the measure and the right side shows the spatial road distribution after implementation of the measure [Noise Reduction Plan Berlin 2008]

Objective of the measure:
Further development of measures regarding road space included in the noise reduction planning in order to reduce the air pollution of residents in highly polluted main roads.

References:

- Air Quality Plan for Berlin 2011-2017, https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf

BUDGET FOR MEASURES

City of MADRID (Spain) [3 141 991 inhabitants]

Example of the City of Madrid Table of Cost for the New AQP Municipal Measures

MADRID'S AIR QUALITY PLAN 2011-2015
COST OF NEW MUNICIPAL MEASURES

	MEASURE	2011	2012	2013	2014	TOTAL
1. TRANSPORT AND MOBILITY SECTOR		**46,042,673**	**42,465,144**	**27,025,676**	**38,196,125**	**153,729,618**
1.1. DETERRENCE AND RESTRICTION OF THE USE OF PRIVATE MOTOR VEHICLES		**0**	**1,448,969**	**4,079,723**	**5,199,723**	**10,728,415**
1.	- Implementation of a low emission zone (LEZ)	0	25,000	0	0	25,000
2.	- New areas of residential priority and restricted vehicle traffic areas within the LEZ	0	0	770,000	1,230,000	2,000,000
3.	- Completely pedestrianizing areas	0	0	200,000	400,000	600,000
4.	- Reduction of road capacity on LEZ routes	0	60,000	440,000	900,000	1,400,000
5.	- Implementation of a separate RPS rate within the LEZ	0	25,000	0	0	25,000
6.	- Expanded RPS schedule	0	1,338,969	2,669,723	2,669,723	6,678,415
7.	- Implementation of an intelligent RPS	-	-	-	-	NAD
8.	- Regulate the prohibition on keeping motors running on parked vehicles	-	-	-	-	NAD
1-2. PROMOTION OF CLEANER TECHNOLOGIES AND CLEANER FUELS		**68,503**	**51,302**	**46,967**	**0**	**166,772**
9.	- Electric Vehicle Promotion and Implementation Strategic Plan Framework	68,503	51,302	46,967	0	166,772
10.	- Consolidate and expand the supply points for cleaner fuels	-	-	-	-	PF
11.	- Consolidate and expand government measures to promote the use of cleaner technologies and cleaner fuels	-	-	-	-	NAD
12.	- Consolidation and strengthening renewal of the municipal fleet of vehicles to cleaner technology	-	-	-	-	NAD
1.3. PROMOTION OF A MORE EFFICIENT AND SUSTAINABLE PUBLIC TRANSPORT		**45,810,702**	**39,587,173**	**19,237,986**	**21,453,402**	**126,089,263**
1.3.1. Taxi						
13.	- New schedule regimen	-	-	-	-	PF
14.	- Drive to renew taxi fleet to cleaner technology	344,000	344,000	700,000	344,000	1,376,000
1.3.2. City buses (EMT)						
15.	- 100% of the EMT Bus Fleet within the LEZ with clean technology	44,894,702	37,943,173	16,714,986	1,249,402	100,802,263

	MEASURE	2011	2012	2013	2014	TOTAL
50.	- Reduce pollution via street cleaning	-	100,000	100,000	300,000	500,000
51.	- Renew street cleaning fleet to new technology	-	-	-	-	CU
52.	- Renew waste water purification equipment motors to new technology	0	0	2,211,615	2,302,888	4,514,503
5. URBAN PLANNING		-	-	-	-	-
53.	- Integrate items concerning air quality into the new General Plan for Urban Zoning	-	-	-	-	NAD
54.	- Roadway system review and development	-	-	-	-	CU
55.	- City centre revitalization measures	-	-	-	-	CU
56.	- Eco neighbourhoods: towards a more global idea of sustainability	-	-	-	-	CU
6. NATURAL HERITAGE		**0**	**0**	**0**	**0**	**0**
57.	- Consolidate the contribution to the fight against air pollution of the city's natural heritage	-	-	-	-	NAD
58.	- Reduce polluting emissions from maintenance tasks in green areas	-	-	-	-	NAD
7. REFUERZO DE LA INTEGRACIÓN DE LAS CONSIDERACIONES RELATIVAS A LA CALIDAD DEL AIRE EN POLÍTICAS MUNICIPLAES		**25,000**	**25,000**	**25,000**	**25,000**	**100,000**
59.	- Improve municipal governance	-	-	-	-	NAD
60.	- Green public contracting drive	-	-	-	-	NAD
61.	- Promotion of sustainable events	-	-	-	-	NAD
62.	- Promotion of more sustainable sports activities and infrastructures	25,000	25,000	25,000	25,000	100,000
8. MONITORING, FORECASTING AND INFORMATION SYSTEMS		**151,000**	**475,000**	**449,323**	**86,324**	**1,161,647**
63.	- Improve the air quality monitoring, forecasting and information system of Madrid	107,000	326,000	360,323	10,324	803,647
64.	- Improvements in the application of data control and analysis within air quality forecasting and information systems	40,000	105,000	45,000	50,000	240,000
65.	- Development of air quality indicators within Madrid's Health Monitoring System of Environmental Factors	4,000	44,000	44,000	26,000	118,000
9. TRAINING, INFORMATION AND AWARENESS		**0**	**70,000**	**210,000**	**90,000**	**370,000**
66.	- Train municipal service personnel on sustainability	-	-	-	-	NAD
67.	- Offer training on air quality at schools	-	-	-	-	NAD
68.	- Training to promote sustainable mobility	-	-	120,000	-	120,000

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- HBEFA - Handbook Emission Factors for Road Transport, http://www.hbefa.net
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Commission Directive (EU) 2015/1480 of 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality

Commission Implementing Decision 2011/850/EU of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C (2011) 9068) ('IPR Decision')

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ('Habitats Directive')

Directive (EU) 2016/2284 of 14 December 2016 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC ('National Emissions Ceilings Directive' - NECD)

Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment ('Strategic Environmental Assessment' - SEA Directive)

Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC ('Public Participation Directive' - PPD)

Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air ('Fourth Daughter Directive')

Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community ('INSPIRE Directive')

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe ('Ambient Air Quality Directive' - AAQD)

Directive 2011/92/EU of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment ('Environmental Impact Assessment' - EIA Directive)

Directive 2014/52/EU of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ('EIA Directive - Amended')

APPENDIXES

I List of mandatory elements of an Air Quality Plan

This Appendix shows the list of information to be included in the local, regional or national air quality plans for improvement in ambient air quality, as included in Annex XV - Part A of Directive 2008/50/EC.

ANNEX XV

Information to be included in the local, regional or national air quality plans for improvement in ambient air quality

A. **Information to be provided under article 23 (air quality plans)**

1. *Localisation of excess pollution*

   (a) region;

   (b) city (map);

   (c) measuring station (map, geographical coordinates).

2. *General information*

   (a) type of zone (city, industrial or rural area);

   (b) estimate of the polluted area (km^2) and of the population exposed to the pollution;

   (c) useful climatic data;

   (d) relevant data on topography;

   (e) sufficient information on the type of targets requiring protection in the zone.

3. *Responsible authorities*

   Names and addresses of persons responsible for the development and implementation of improvement plans.

4. *Nature and assessment of pollution*

   (a) concentrations observed over previous years (before the implementation of the improvement measures);

   (b) concentrations measured since the beginning of the project;

(c) techniques used for the assessment.

5. *Origin of pollution*

(a) list of the main emission sources responsible for pollution (map);

(b) total quantity of emissions from these sources (tonnes/year);

(c) information on pollution imported from other regions.

6. *Analysis of the situation*

(a) details of those factors responsible for the exceedance (e.g. transport, including cross-border transport, formation of secondary pollutants in the atmosphere);

(b) details of possible measures for the improvement of air quality.

7. *Details of those measures or projects for improvement which existed prior to 11 June 2008, i.e:*

(a) local, regional, national, international measures;

(b) observed effects of these measures.

8. *Details of those measures or projects adopted with a view to reducing pollution following the entry into force of this Directive:*

(a) listing and description of all the measures set out in the project;

(b) timetable for implementation;

(c) estimate of the improvement of air quality planned and of the expected time required to attain these objectives.

9. *Details of the measures or projects planned or being researched for the long term.*

10. *List of the publications, documents, work, etc., used to supplement information required under this Annex.*

II List of existing guidelines for Air Quality Plans

It is not easy to find guidelines on how to draft and implement Air Quality Plans at local level that could be used by cities of different EU Member states, also due to the different implementation of Dir. 2008/50/EC in the various EU countries. This is the motivation for drafting this Code, which has been produced to help cities and local authorities fulfil EU legislation applicable to Air quality planning, and thus protect the health of citizens and of the environment.

The UK, for instance, in the implementation of Dir. 2008/50/EC has developed Technical Guidelines that are different for England, Scotland, Wales and for the London area. In the present Code the most recent Technical Guidance for Northern Ireland (DEFRA, 2018) has been considered, seeming to be nearest to legislation for Cities AQPs of other EU Countries. Well before the adoption of the Dir. 2008/50/EC the UK National Society for Clean Air and Environmental Protection drafted an Interim Guidance for Local Authorities AQPs (NSCA, 2000), but indication need to be adapted to the present legislative context.

Two other interesting Technical Guidance documents are respectively, the one edited by the German Environment Agency and addressed to the Bulgarian Government (Umweltbundesamt, 2015), and the one commissioned by the Italian Ministry to the Italian Environmental Agencies System (SNPA, 2016) for Regions - who are in charge for AQPs in Italy - both focused on the content of the AQP and on available instruments for assessment and air quality modelling, rather than on the process to follow for adopting the Directive. Others Guidance documents found in research literature are focused on specific topics (air quality modelling tools, air quality measures, etc.) and are cited in the Code in the related section.

EXISTING GUIDELINES FOR DRAFTING AQPs:

- DEFRA, 2018: Local Air Quality Management Technical Guidance (TG16), Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, February 2018 https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
- NSCA - National Society for Clean Air and Environmental Protection, 2000: Air Quality Plans: Interim Guidance for Local Authorities, Air Quality Plans Working Group of NSCA's Air Quality Committee, 2000 https://laqm.defra.gov.uk/assets/aqactionplansinterim.pdf
- SNPA - Sistema Nazionale per la Protezione dell'Ambiente, Gruppo di Lavoro Interagenziale 30, 2016 - Linee Guida per la redazione dei Piani di Qualità dell'Aria di cui all'art. 9 del D.Lgs. 155/2010, 29 Novembre 2016

  http://www.isprambiente.gov.it/files/snpa/consiglio-federale/Delibera90cfPropostaLLGGredazionepianidiqualitdellariaconallegati.pdf

II - List of existing guidelines for Air Quality Plans

- UBA, 2016 - Guideline on Air Quality Plans, August 2016, ISSN 2363-832X
  https://www.umweltbundesamt.de/en/publications
- DEFRA, 2018 - Air Quality Action Planning and Good Practice
  http://laqm.defra.gov.uk/action-planning/good-practice.html

Some EXISTING GUIDELINES on Health Impact/related Citizens Awareness/AQ Measures

- DEFRA and Public Health England, 2017: Air Quality: A Briefing for Directors of Public Health, March 2017
  https://www.local.gov.uk/sites/default/files/documents/6.3091_DEFRA_AirQualityGuide_9web_0.pdf
- GLA - Greater London Authority, 2012: Air Quality in City of London: A Guide for Public Health Professionals, November 2012
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- ENVII Committee, 2016: Implementation of Ambient Air Quality
  http://www.europarl.europa.eu/RegData/etudes/STUD/2016/578986/IPOL_STU(2016)578986_EN.pdf

Some EXISTING GUIDELINES on AQ Measures:

- UBA, 2015: Inventory and effectiveness of measures to improve air quality, TEXTE 05/2015, ISSN 1862-4804
  http://www.umweltbundesamt.de/publikationen/inventory-effectiveness-of-measures-to-improve-air
- X. Querol and F. Amato (eds.) 2017: GUIDEBOOK: Measures to Improve Urban Air Quality, AIRUSE Project, ISBN: 978-84-697-5499-3, September 2017
  http://www.cleanaircities.net/
- EEA - European Environment Agency, 2013: Air Implementation Pilot. Lessons learnt from the implementation of air quality Legislation at urban level, EEA Report No 7/2013, ISSN 1725-9177
  https://www.eea.europa.eu/publications/air-implementation-pilot-2013/file
- ETC/ACM - European Topic Centre on Air Pollution and Climate Change Mitigation, 2013: Air Implementation Pilot: Workshop on measures, Copenhagen, February 27th, 2013 - ETC/ACM Technical paper 2013/5, June 2013

TRANSPORT

- *Low Emission Zones:* http://urbanaccessregulations.eu/

II - List of existing guidelines for Air Quality Plans

LAND USE PLANNING

- EPUK & IAQM, 2017: Land-Use Planning & Development Control: Planning For Air Quality. Guidance from Environmental Protection UK and the Institute of Air Quality Management for the consideration of air quality within the land-use planning and development control processes, January, 2017
http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

CONSTRUCTION SECTOR

- https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/control-dust-and

Some EXISTING GUIDELINES on AQ Modelling:

- Belis C., et al, 2014: European Guide on with Receptor Models Air Pollution Source Apportionment, European Commission Joint Research Centre Institute for Environment and Sustainability, Report EUR 26080 EN, ISBN 978-92-79-32513-7, doi: 10.2788/9307
https://ec.europa.eu/jrc/en/publication/reference-reports/european-guide-air-pollution-source-apportionment-receptor-models
- G. Guariso and M. Volta (eds.) 2017, Air Quality Integrated Assessment, PoliMI SpringerBriefs, DOI 10.1007/978-3-319-33349-6_1, November 2017
https://www.springer.com/gp/book/9783319333489
- JRC - Joint Research Centre, 2014: European Guide on with Receptor Models Air Pollution Source Apportionment, European Commission Joint Research Centre Institute for Environment and Sustainability, Report EUR 26080 EN, ISBN 978-92-79-32513-7
https://ec.europa.eu/jrc/en/publication/reference-reports/european-guide-air-pollution-source-apportionment-receptor-models
- Miranda A. et al, 2015: Current air quality plans in Europe designed to support air quality management policies, Atmospheric Pollution Research 6 (2015) 434 443
https://www.sciencedirect.com/science/article/pii/S1309104215302129
- VITO, 2015: WP4 Guidance on integrated air quality and health assessment systems. D4.4 Final Version of the Guidance document (version 1.1), FP7 Appraisal project, 8 June 2015.
www.appraisal-fp7.eu
- P. Thunis, B. Degraeuwe, E. Pisoni, F. Ferrari and A. Clappier, 2016: On the design and assessment of regional air quality plans: The SHERPA approach, Journal of Environmental Management 183
https://core.ac.uk/download/pdf/82813188.pdf

III List of existing guidelines for Short-term Action Plans

Short-term action plans are defined by Art. 24 of Directive 2008/50/EC.

An existing collection of Best Practices for implementing Short-term action plans, that can be seen as a sort of Guidance, is given in the following report:

- AEA and Umweltbundesamt, 2012: Best Practices for Short-term action plans, Report for the European Commission, January 2012 http://ec.europa.eu/environment/air/quality/legislation/pdf/SC5_Task%201_report.pdf

EXAMPLES of short-term action plans

- STRASBOURG (France)

  https://www.bisonfute.gouv.fr/IMG/pdf/Strasbourg_Dossier_de_presse_du_3_juillet_17.pdf

- MANNHEIM (Germany)

  https://rp.badenwuerttemberg.de/rpk/Abt5/Ref541/Luftreinhalteplan/rpk54.1_lrp_fortschr_jan12.pdf

- PO VALLEY BASIN Agreement (Italy)

  http://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/servizi-e-informazioni/cittadini/Tutela-ambientale/Qualita-dell-aria/misure-di-limitazione-per-qualita-aria/misure-di-limitazione-per-qualita-aria

IV Cities Air Quality Plans: examples of best practices

BERLIN

Air Quality Plan for Berlin 2011-2017
https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf
(English full version)

Themes and pollutants: traffic (NO_2, PM_{10}, diesel soot), construction sites (PM_{10}, diesel soot).

Objective: for compliance with EU Limit Values for NO_2 and PM_{10} in long term for the whole city territory; to protect citizens health reducing the number, duration and intensity of the exceedances.

For AQP structure:

- ✓ A full version in English

For consistent implementation of Dir. 2008/50/EC

For attention for social equity in air pollution exposure and related health effects (Environmental justice as a model scheme):

- ✓ Socio-spatial distribution maps of air pollutants in Berlin considered for Urban Planning and AQ measures

For Citizen Awareness efforts:

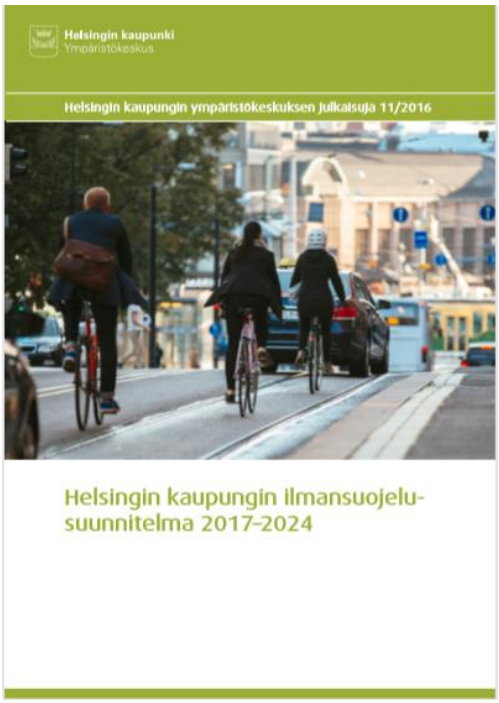
- ✓ An **AQP Brochure** to explain easily the Plan to the citizens: https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_broschuere_en.pdf
- ✓ **maps of congestion, emissions and air pollution** on the main road network created for the Air Quality Plan are made available in Berlin's Environmental Atlas: http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/dinh_03.htm
- ✓ **Information on air pollution** available on the website of the Senate Department for Urban Development and Environment: http://www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/

HELSINKI

Air Quality Plan of the City of Helsinki 2017-2024
https://www.hel.fi/static/ymk/julkaisut/julkaisu-11-16.pdf
(English summary)

Themes and pollutants: traffic (NO_2, $PM_{2.5}$), street dust (PM_{10}), wood burning ($PM_{2.5}$, B(a)P)

Objective: to get below the annual limit value for NO_2, to generally improve the air quality in Helsinki



For AQP structure:

- ✓ a short summary in English for each report;
- ✓ a separate detailed report with Analysis of Air Quality situation a part from the AQP:

Background Report of the AQP of the City of Helsinki 2017-2024 *(English summary)*

For Participatory process:

- ✓ Public consultation and Stakeholder involvement description in a dedicated publication:

Interaction Report of the AQP of the City of Helsinki 2017-2024 *(English summary)*
https://www.hel.fi/static/ymk/ilmansuojelu/vuorovaikutusraportti.pdf
(See also *Section 6.2* of this Code)

For Citizen Awareness efforts:

- ✓ An air quality citizens awareness brochure
  Clean Air for Helsinki - Brochure *(English version)*
  www.hel.fi/air-protection
- ✓ A website with real time information on air quality situation:
  Air quality in the Helsinki Metropolitan Area – Website
  www.hsy.fi/airquality

Legislation on Air pollution control in Finland
http://www.ym.fi/en-US/The_environment/Legislation_and_instructions/Climate_protection_legislation

STRASBOURG

Plan de Protection de l'Atmosphère de l'agglomeration strasbourgeoise, 2015-2020
http://www.bas-rhin.gouv.fr/Politiques-publiques/Environnement-prevention-des-risques-naturels-et-technologiques/Air/Plan-de-Protection-de-l-Atmosphere-de-l-agglomeration-strasbourgeoise-PPA

Themes and pollutants: PM_{10}, NO_2

Objective: Compliance with EU Limit Values for NO_2 and PM_{10}; to reduce citizens' exposure and AQ related health impact also to local exceedances

For AQP structure:

- ✓ rigorous structure and detailed report
- ✓ Impact assessment of measures finalized to consider 'citizens exposure' to several pollutants

For consistent implementation of Dir. 2008/50/EC

For APHEKOM approach in health assessment

For Citizen Awareness efforts:
http://www.laircmonaffaire.net/advices_notes.php?PHPSESSID=28d51b5be9fae3a2c96dee63ff2de88e

ZAGREB

Air Quality Plan of the City of Zagreb (2015-2023)

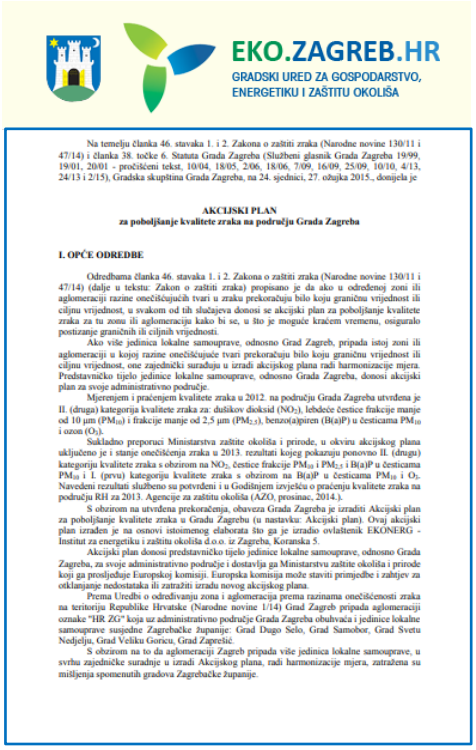
http://www.eko.zagreb.hr/default.aspx?id=247

Themes and pollutants: traffic (NO_2, PM_{10}, $PM_{2.5}$), households plants (PM_{10}, benzo(a)pirene), expansion of measuring stations network for continuous AQ monitoring

Objective: Air quality improvement in the territory of the City of Zagreb and compliance with EU Limit Values. A significant effect on reduction of levels of nitrogen oxides (NO_x), PM_{10} and $PM_{2.5}$ and benzo(a)pyrene - B(a)P and Ozone (O_3) is expected.

For AQP structure:

- ✓ A full version in Croatian (SGGZ 5/15): Action Plan for Improving Air Quality in the City of Zagreb


EKO.ZAGREB.HR
GRADSKI URED ZA GOSPODARSTVO, ENERGETIKU I ZAŠTITU OKOLIŠA

Na temelju članka 46. stavaka 1. i 2. Zakona o zaštiti zraka (Narodne novine 130/11 i 47/14) i članka 38. točke 6. Statuta Grada Zagreba (Službeni glasnik Grada Zagreba 19/99, 19/01, 20/01 - pročišćeni tekst, 10/04, 18/05, 2/06, 18/06, 7/09, 16/09, 25/09, 10/10, 4/13, 24/13 i 2/15), Gradska skupština Grada Zagreba, na 24. sjednici, 27. ožujka 2015., donijela je

AKCIJSKI PLAN
za poboljšanje kvalitete zraka na području Grada Zagreba

I. OPĆE ODREDBE

Odredbama članka 46. stavaka 1. i 2. Zakona o zaštiti zraka (Narodne novine 130/11 i 47/14) (dalje u tekstu: Zakon o zaštiti zraka) propisano je da ako u određenoj zoni ili aglomeraciji razine onečišćujućih tvari u zraku prekoračuju bilo koju graničnu vrijednost ili ciljnu vrijednost, u svakom od tih slučajeva donosi se akcijski plan za poboljšanje kvalitete zraka za tu zonu ili aglomeraciju kako bi se, u što je moguće kraćem vremenu, osiguralo postizanje graničnih ili ciljnih vrijednosti.

Ako više jedinica lokalne samouprave, odnosno Grad Zagreb, pripada istoj zoni ili aglomeraciji u kojoj razine onečišćujuće tvari prekoračuju bilo koju graničnu vrijednost ili ciljnu vrijednost, one zajednički surađuju u izradi akcijskog plana radi harmonizacije mjera. Predstavničko tijelo jedinice lokalne samouprave, odnosno Grada Zagreba, donosi akcijski plan za svoje administrativno područje.

Mjerenjem i praćenjem kvalitete zraka u 2012. na području Grada Zagreba utvrđena je II. (druga) kategorija kvalitete zraka za: dušikov dioksid (NO_2), lebdeće čestice frakcije manje od 10 µm (PM_{10}) i frakcije manje od 2,5 µm ($PM_{2,5}$), benzo(a)piren (B(a)P) u česticama PM_{10} i ozon (O_3).

Sukladno preporuci Ministarstva zaštite okoliša i prirode, u okviru akcijskog plana uključeno je i stanje onečišćenja zraka u 2013. rezultati kojeg pokazuju ponovno II. (drugu) kategoriju kvalitete zraka s obzirom na NO_2, čestice frakcije PM_{10} i $PM_{2,5}$ i B(a)P u česticama PM_{10} i I. (prvu) kategoriju kvalitete zraka s obzirom na B(a)P u česticama PM_{10} i O_3. Navedeni rezultati službeno su potvrđeni i u Godišnjem izvješću o praćenju kvalitete zraka na području RH za 2013. Agencije za zaštitu okoliša (AZO, prosinac, 2014.).

S obzirom na utvrđena prekoračenja, obaveza Grada Zagreba je izraditi Akcijski plan za poboljšanje kvalitete zraka u Gradu Zagrebu (u nastavku: Akcijski plan). Ovaj akcijski plan izrađen je na osnovi istoimenog elaborata što ga je izradio ovlaštenik EKONERG - Institut za energetiku i zaštitu okoliša d.o.o. iz Zagreba, Koranska 5.

Akcijski plan donosi predstavničko tijelo jedinice lokalne samouprave, odnosno Grada Zagreba, za svoje administrativno područje i dostavlja ga Ministarstvu zaštite okoliša i prirode koji ga prosljeđuje Europskoj komisiji. Europska komisija može staviti primjedbe i zahtjev za otklanjanje nedostataka ili zatražiti izradu novog akcijskog plana.

Prema Uredbi o određivanju zona i aglomeracija prema razinama onečišćenosti zraka na teritoriju Republike Hrvatske (Narodne novine 1/14) Grad Zagreb pripada aglomeraciji oznake "HR ZG" koja uz administrativno područje Grada Zagreba obuhvaća i jedinice lokalne samouprave susjedne Zagrebačke županije: Grad Dugo Selo, Grad Samobor, Grad Sveta Nedjelja, Grad Veliku Goricu, Grad Zaprešić.

S obzirom na to da aglomeraciji Zagreb pripada više jedinica lokalne samouprave, u svrhu zajedničke suradnje u izradi Akcijskog plana, radi harmonizacije mjera, zatražena su mišljenja spomenutih gradova Zagrebačke županije.

For consistent implementation of Dir. 2008/50/EC:

- ✓ The Air Quality Plan of the City of Zagreb format and content are defined in accordance with national legislation in which the provisions of 2008/50/EC Directive have been transposed
- ✓ For regular monitoring reporting:
  - 2015 and 2016 Report on the Implementation of the Action Plan for the Improvement of Air Quality in the City of Zagreb
- ✓ For integration with other Plans and Programmes at local and national scale:
  - *Programme of the City of Zagreb for the protection of air, ozone layer, climate change adaptation and mitigation;*
  - *Sustainable Energy Action Plan for the development of the City of Zagreb (SEAP*);
  - *Plan for the protection of air, ozone layer and climate change mitigation in the Republic of Croatia for the 2013- 2017 period* (OG 139/13).
- ✓ For tacking B(a)P emissions and reduction of ground-level ozone pollution (O_3). For reduction of O_3 precursors (e.g. NO_x, VOC) local measures are not sufficient, and action by the international community within the framework of LRTAP and the related Gothenburg protocol is required.

Legislation on Air pollution control in Republic of Croatia

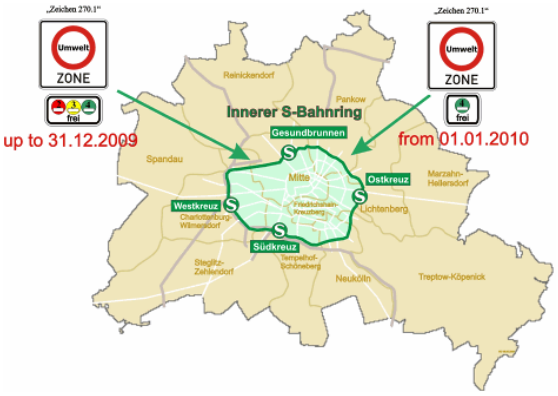
http://www.mzoip.hr/en/environment/regulations-and-international-treaties-ratified-or-signed-by-the-republic-of-croatia.html

V Examples of Air Quality measures

TRANSPORT MEASURES

Low Emission Zone - LEZ for trucks and cars (Berlin)

This emission-based limited traffic zone includes the inner city of Berlin within the suburban rail ring. It covers about 85 km^2 of a very densely built-up area with more than 1 million residents. The traffic restriction applies permanently and independently from the current pollution level of the air. It is based on German vehicle emissions level classification for which three coloured stickers have been settled to label lowest emission vehicles (highly emitting vehicles have no sticker) in order to help roadside controls in LEZs implementation.



Emission standard (Euro norm)	Polluant Class	Initial vehicle rigistration passenger cars	Sticker
Diesel engine			
Euro 1 or older	1	before 01.01.1997	none
Euro 2 / Euro 1 + filter	2	from 01.01.1997 to 31.12.2000	
Euro 3 / Euro 2 + filter	3	from 01.01.2001 to 31.12.2005	
Euro 4 / Euro 3 + filter	4	from 01.01.2006	
Petrol engine			
Before Euro 1	1	before 01.01.1993	none
Euro 1 and better	4	from 01.01.1993	

Source: *https://www.berlin.de/senuvk/umwelt/luftqualitaet/de*

The following requirements are effective for the whole area of the LEZ, settled in 2005. *Stage I* from 1.1.2008: Vehicles (trucks and cars) must at least be up to the standards of the emission group 2. Vehicles of emission groups 2, 3 and 4, i.e. with red, yellow or green stickers, are allowed to drive. *Stage II* from 1.1.2010: Only vehicles of emission group 4, i.e. with a 'green sticker', are allowed to drive.

LEZ results in Berlin were assessed in term of vehicular emissions avoided as in the followings. *Stage I*: - 24% of diesel soot, - 14% NOx; *Stage II*: - 58% of diesel soot, compared to trend without LEZ.

In the framework of the AQ Plan of Berlin 2011-2017, in consideration of the persistent high fraction of Euro 3 diesel vehicles without a particulate filter due to individual exemptions it was decided to limit those only to few categories. The effects of this tightening of the LEZ was assessed by modelling for main roads a reduction of vehicular emissions: - 3.6 t/a of diesel soot (or -3.6% black carbon emissions); - 55 t/a (-1.1%) of NOx emissions. However, benefits in term of emissions reduction and air quality are expected also in minor roads and beyond the boundary of the LEZ.

V - Examples of Air Quality measures

In term of air quality the effect of the LEZ was assessed in the framework of the AQ Plan of Berlin together with the others 'vehicles technology' measures: the number of residents on main roads affected by EU limit value exceedances could be reduced approximatively by 25% for PM_{10} and by 46% for NO_2 thanks also the LEZ *Stage II* implementation. Notably this kind of measure allows to reduce the exposure to traffic proximity primary pollutant (-5% of NO_2 and -50% of diesel soot/Black Carbon concentration measured) and less to secondary pollutants such as PM_{10}, more affected by larger scale pollution phenomena.

Berlin experience showed that to reduce the economic and social consequence of this measure it is useful introduce different stages with long transitional periods and economic incentives for scrappaging older vehicles to help vehicle owner. Lesson learnt is also that the city management of granting individual exemptions is a human resources cost to be considered in planning.

For more details:

- https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/paper_lez_berlin_en.pdf
- https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf
- Brukmann and Lutz, 2011: Do Low Emission Zones reduce the burden of particulates?, XV ETH Conference on Combustion Generated Nanoparticles, Zurich, June 26th-29th 2011

Additional information about LEZ in German Cities could be found in the following document:

- UBA, 2015: Inventory and effectiveness of measures to improve air quality, TEXTE 05/2015, ISSN 1862-4804 http://www.umweltbundesamt.de/publikationen/inventory-effectiveness-of-measures-to-improve-air

Congestion Charge (London) - Road pricing to reduce congestion

The congestion charging scheme in London was introduced in February 2003. This road charging scheme charges a daily rate for vehicles to enter and travel in the 21 square kilometres central zone between 7:00 and 18:30 during weekdays. The scheme is supported by an infrastructure of camera sites, using automatic number plate recognition (ANPR) technology cameras placed on the entry points into the congestion zone and in locations within the zone.

Source: https://tfl.gov.uk/modes/driving/congestion-charge/congestion-charge-zone/road-signs

Vehicles driving in the charging zone during the charging period are charged a flat rate of £10 per day. Vehicles exempt from the scheme include licensed taxis and minicabs, buses, motorcycles, vehicles for disabled persons including "blue badge" holders and vehicles with 9 seats or more. Residents in the charging zone - of which approximately 40,000 households own a car - are entitled to a 90% discount of the charge.

Within the charging zone road traffic flows have decreased by 15% and mean daily traffic speed has increased by 20 per cent (from 19 km/h to 23 km/h). Congestion in the charging zone has been reduced by 30%. Car trips into the central charging zone has reduced by 65,000 - 70,000 per day. Changes in vehicle km travelled in the charging zone shows an increase in buses (+20%), an increase in taxis (+13%) and a decrease in cars (-29%) and heavy goods vehicles (-11%).

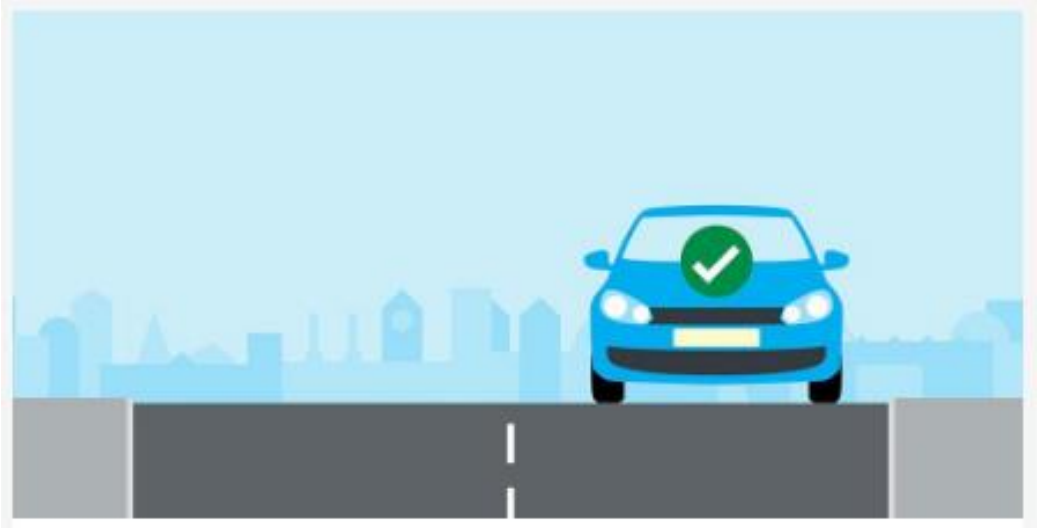
Bus usage has increased inside and outside the congestion charging zone. In terms of air quality, congestion charging in London has been found to reduce emissions of nitrogen oxides and particulates by 12% and carbon dioxide by 19% within the charging zone.

For more details:

- http://www.tfl.gov.uk/roadusers/congestioncharging/default.aspxhttp://www.tfl.gov.uk/roadusers/congestioncharging/default.aspx

T-Charge (London)

The Mayor of London has launched a £10 toxicity 'T-Charge' aimed at older, more polluting vehicles on London roads. The T-Charge, which went into force on 23 October 2017, applies mainly to diesel and petrol vehicles registered before 2006, but also includes later models. The T-Charge aims to help improve air quality in London, in particular with regard to nitrogen dioxide (NO_2) and particulate matter (PM), both of which have an adverse effect on human health.



Source: https://www.london.gov.uk/what-we-do/transport/mayors-new-ps10-toxicity-charge-londons-most-polluting-cars

The T-Charge (officially known as the 'Emissions Surcharge') aims to discourage the use of older, more polluting vehicles driving into and within central London. The T-Charge applies in the same area as the existing Congestion Charging Zone.

It is the first step towards the introduction of the Ultra Low Emission Zone (ULEZ), a 24-hour charging zone in central London for older vehicles.

For more details:

- https://www.london.gov.uk/what-we-do/transport/mayors-new-ps10-toxicity-charge-londons-most-polluting-cars

Environmental Bonus for Buses Cutting Emissions (Helsinki)

Source: https://www.smartcitiesworld.net/news/news/app-teaches-helsinki-citizens-about-pollution-1793

Helsinki's goal is emission-free public transport by 2025.

Environmental bonuses are paid on the basis of a tendering process to bus operators for measures to cut emissions. The tendering process takes account of both carbon emissions and harmful local emissions such as small particles and nitrogen oxides. The emphasis is on reducing nitrogen oxides and carbon emissions.

Bonuses are paid for new measures that exceed the commitments set out in the currently valid contracts. Helsinki assesses the measures offered and pays bonuses according to the emission reductions achieved. The costs of emissions avoided are assessed according to the Directive 2009/33/EC. Measures are ranked according to their cost-effectiveness and they are procured with the allotted sum of money (1 million euros in 2016). The bonus has been applied to finance emission reductions by using biofuels and by retrofitting EEV buses with high NO_2 emissions (15 000 euros per retrofitted bus).

After the retrofit the emissions of these EEV buses in real world driving were measured and found to be on the Euro VI level. There is an environmental zone in the city centre applying to local Helsinki buses and Helsinki waste collection vehicles. When new lines and areas are opened for competitive bidding, the buses and waste collection vehicles operating within the environmental zone must comply with the Euro VI emission norms. The environmental zone covers the Southern part of the Hakamäentie road.

For more details:

- https://www.hsl.fi/en/news/2016/hsl-invests-one-million-euros-reducing-emissions-9094

Cleaning public transport (Berlin)

Source: https://www.berlin.de/

The public transport company of Berlin (BVG) operates a fleet of currently about 1,320 buses. These buses are equipped since the late 1990s gradually with particle filters. Prior to entry into force of the Clean Air Plan 2005, about 72 % of the buses were equipped with particulate filters. With these filters, the particulate emission of buses was reduced by about 70-90%. In addition to the particle emission the buses also contribute significantly to local pollution by nitrogen oxides. In 2005 the following goals to reduce emissions of the buses were set out in the Clean Air Plan: full retrofitting with particulate filters by 2010 and conversion to Euro5/EEV-Standard of 600 buses by 2010.

The objectives of the Clean Air Plan were implemented in the local transport plan (NVP) of Berlin from 2006 to 2009 and incorporated in the draft NVP 2010-2014. The BVG has procured between 2005 and 2010 a total of 923 buses, 161 of them with the exhaust emission standard Euro 3, 409 with Euro 4 and 353 with EEV/Euro 5.

All newly purchased diesel buses are equipped with a closed particulate filter.

For more details:

- http://www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/de/luftreinhalteplan/download/Luftreinhalteplan_Berlin_2011.pdf

Buses retrofitting for NO_x (Copenhagen)

City buses contribute to a large proportion of air pollution in cities because normal filters and catalysts only function well with high motor temperatures. The low speed and many stops counteract the traditional pollution reduction systems in cities.

In order to improve the air quality for the citizens, 299 diesel busses in Copenhagen has been fitted with an innovating NOx reduction technology that neutralizes NO_x emissions even at low motor temperatures, reducing emissions by 90-95%.

Source: https://ing.dk/artikel/299-busser-i-koebenhavn-har-faaet-nox-og-partikelfiltre-182756

The upgraded fleet is a mix of both older and newer vehicles, and after the upgrade they are robustly meeting Euro VI emissions legislation in all real driving conditions, including congested city driving and at sub-zero temperatures.

City of Copenhagen has reduced NO_x emissions by up to 95% on its public buses since implementing new clean air filters in early 2016. The total amount of NO_x emissions in Copenhagen have been reduced by 4% as a result of the new bus filters.

For more details:

- http://www.cleanaireurope.org/fileadmin/user_upload/redaktion/downloads/The_Danish_Ecocouncil/Clean_air_CPH_2014_UK.pdf
- The Danish Council, 2014: CLEAN AIR COPENHAGEN: Air quality challenges and solutions, ISBN: 978-87-92044-65-5, January 2014

V - Examples of Air Quality measures

Cycling networks, Cycling Highways (Copenhagen/Groningen/London)

A Cycle Super Highway is a cycle highway, where the commuters' needs have been given the highest priority. The project seeks to create routes that offer fast, comfortable and safe service. A Cycle Super Highway is defined both by its location, as well as its physical qualities. The highway should connect areas with many workers and students to their homes, and to public transportation possibilities as well. The highways should be fast, meaning as direct as possible and with as few stops as possible. A good example of how this is achieved is by the use of green waves. Traffic lights are normally coordinated in favour of cars, but the aim for the Cycle Super Highways, is for traffic lights to be adjusted for cyclists along the many main traffic arteries. At a speed of 20 km/h, cyclists will be able to surf a wave of green lights through the city during rush hour.

Source: http://denmark.dk/en/green-living/strategies-and-policies

Furthermore, the highways have to be comfortable and safe. Comfort is secured by the use of high quality asphalt and maintenance. Security is achieved for instance, by clear marking and distance to cars including advanced stop lines, to make cyclists more visible to motorists, as well as sufficient lightning. In order to reduce risks of accidents, many intersections will be restructured in order to give cyclists priority. For example, in intersections with separate traffic lights for bikes, the cyclists may get a green light four seconds before cars would. In some cases, the head start would be as much as 12 seconds. These initiatives make the cyclists far more visible in traffic. In addition, you get to where you're going quicker. Clear signage will make it easy for the commuter to find his way. To minimize clutter, design will be based on traditional signage and we will use existing posts where possible. Maintenance is essential for the commuters, especially during the winter. The Cycle Super Highways will be given the highest priority in each municipality, concerning issues of road repair and snow removal.
For more details:

- http://www.cykelsuperstier.dk/sites/default/files/Cycle%20Super%20Highways.pdf
- http://www.cykelsuperstier.dk/concept
- http://www.aviewfromthecyclepath.com/2009/02/how-groningen-grew-to-be-worlds-number.html
- http://www.tfl.gov.uk/roadusers/cycling/11901.aspx

Parking discount for Low-emission Vehicles (Helsinki)

Source: https://www.ksml.fi/kotimaa/Tuleeko-sakko-jos-parkkimittari-on-rikki-%E2%80%93-pys%C3%A4k%C3%B6inninvalvoja-kertoo/192892

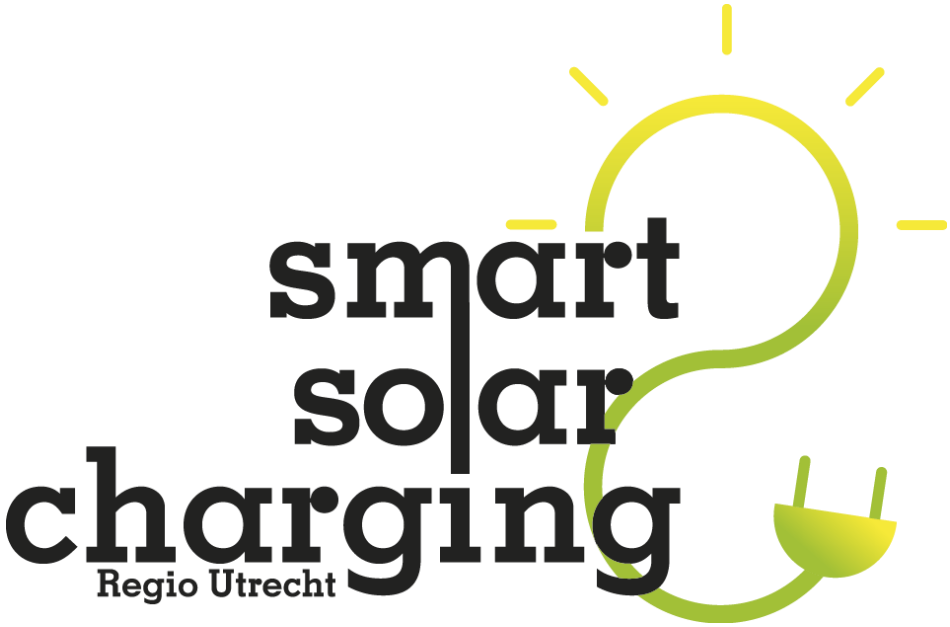
Low-emission vehicles get a 50 % reduction on parking fees in Helsinki. The discount applies to all paid car parks in general traffic areas controlled by the city. It also applies to paid resident and corporate parking permits. In order to get the discount, the parking charge must be paid either by mobile phone or a specific payment device (Comet).

The emission criteria are reviewed regularly. The criteria cover both carbon dioxide emissions and regulated emissions which have an impact on air quality. These emissions are regulated with Euro norms. From the beginning of 2017 the criteria are Euro 5 for all types of cars and specific CO_2 limits depending on the fuel: 50 g/km for diesel cars (only plug-in hybrids fulfil this criteria), 100 g/km for petrol cars and 150 g/km for natural gas (bifuel) and ethanol (flexifuel) cars. All fully electric cars and electrically operated class L vehicles which have been registered for road use are categorized as low-emission vehicles.

For more details:

- http://www.hel.fi/www/helsinki/en/maps-andtransport/parking/vahapaastoisten_alennus

Smart Solar Charging for electric cars (Utrecht)



Source: https://smartsolarcharging.eu/uniek-energiesysteem-in-utrechtse-wijk-lombok-breidt-uit-in-de-regio/

The measure involves the development of renewable energy (solar power) in combination with storage in electric car batteries of a surplus of the decentralized produced power in order to avoid grid stress. Electric cars can be charged and discharged according the demand of the power in the house or the electric car battery. Bidirectional charging points for electric cars, provide optimal use of decentralized generated solar power. At this charging point, the car can both charge and discharge wherever the power is necessary. The car battery is therefore used as a storage unit for solar energy that can be used when necessary.

Solar powered electric mobility is made accessible to a large audience by sharing the costs among users. Through a website 'We Drive Solar' residents can apply for a 100% (shared) electric car with a range of 300 kilometres, which also forms part of a local energy system on solar energy. All residents, businesses and organizations in the province of Utrecht can participate. Entry fee: € 99, - per month, including mileage, insurance and an app to unlock the car. Each car gets its own parking space and charging point. There are 150 cars available.

For more details:

- https://youtu.be/4FehqeU62Jk?list=PLvzHLhum83vvaflbil9BcQPzea1DrB5_6

Street cleaning and dust binding to reduce re-suspension (Helsinki)

Street dust concentrations in Helsinki have been successfully reduced by:

- intensive street cleaning with high-pressure washing equipment;
- dust binding with calcium chloride solution.



Source: http://www.redust.fi/files/2015/03/Laymans-report_net2.pdf

Different methods of cleaning streets were studied in the REDUST Life + project in 2011-2014. The best results for respirable street dust mitigation in the street cleaning demonstration tests were achieved with methods which apply high pressure water washing, such as the modern street scrubber. During first day after treatment the emission reduction was approximately 40% and during the first week after treatment on an average 20%. Compared to traditional street cleaning equipment (so-called suction sweepers) the modern street scrubber has additional high pressure washers which reach the dust accumulated in the pores of street surfaces. Reduction in respirable street dust emissions was not recorded for a traditional suction sweeper in the demonstration testing. The traditional method is based on mechanical brushing and suction, which does not deep-clean the street surface like the machines with actual pressure washers. But when the traditional suction sweeper was operated in combination with a separate lorry using high pressure washing, reductions in respirable street dust emissions were achieved.

Dust binding refers to the spreading of liquid solutions on paved streets to mitigate street dust emissions. In the Helsinki region mainly calcium chloride is used for dust binding.

The effects of dust binding on street dust emissions were studied in the REDUST Life + project in 2011-2014. The results showed that dust binding is a very cost-effective way to reduce high street winter and springtime dust concentrations in road environments. Targeted dust binding to street edges and to the area in the middle of the lanes decreased street dust emissions by approximately 40% during two days after the action and whole lane dust binding by approximately 60% for three days after the action.

For more details:

- REDUST Life + project website, Layman´s report: http://www.redust.fi/files/2015/03/Laymans-report_net2.pdf
- REDUST Life + project website, Best practices report: http://www.redust.fi/files/2014/12/REDUST-best-practices.pdf

CONSTRUCTION SECTOR MEASURES

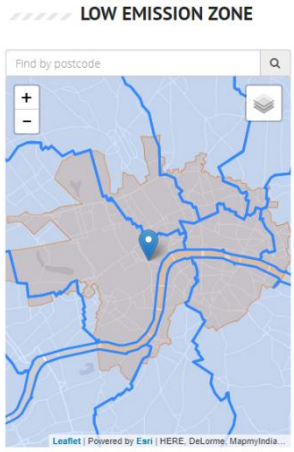
Non-Road Mobile Machinery Low Emission Zone - NRMM LEZ (London)

LONDON'S 'LOW EMISSION ZONE' FOR NON-ROAD MOBILE MACHINERY

Low emission zone for non-road machinery e.g. construction machinery: within central areas of London all NRMM must meet Stage 3B (3A in outside central London).

For more details:

- http://nrmm.london/



Source: http://nrmm.london/

Particle Filters eco-label for construction machinery (Berlin)

On public works sites in Berlin, many construction machines have to meet environmental requirements. Compliance with the requirements must be demonstrated by the contractor. To simplify this, an eco-plaque for construction machinery was created in Berlin: it is an eco-label in terms of public procurement law.

The environmental standards required on public works sites in Berlin are usually met by new machines without further systems. Older machines can still be used if they are retrofitted with a particulate filter. In these filters, the very smallest soot particles are retained, so that both the particle mass and the number of particles in the exhaust gas are reduced by more than 90%.

The introduction of environmental standards for construction equipment and filter retrofitting is a new challenge for many construction companies. For a successful retrofit, careful filter selection and proper maintenance are essential. Therefore, the Senate Department for Urban Development and Environment promotes a consultancy project by 2016 that provides companies with technical support.

Source: https://www.berlin.de/

For more details:

- https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/baumaschinen/plaketten.shtml

HEATING SUPPLY MEASURES

Ban of solid fuels for household heating (Kraków)

The European Environmental Agency has ranked the City of Krakow the third most polluted city in Europe. Being air quality an issue for a long time in the city of Krakow it has inspired grass-root initiatives such as the Krakow Smog Alert (Krakowski Alarm Smogowy).

Source: http://www.krakowpost.com

Acceleration of anti-smog activities was possible thanks to the LIFE Integrated Project 'Implementation of Air Quality Plan for Małopolska Region - Małopolska in a healthy atmosphere', LIFE-IP MALOPOLSKA - a project implemented by the regional authorities of the Małopolska Region and Silesian Region, the Krakow Smog Alert and 55 municipalities including the City of Krakow.

The Regional Assembly of the Małopolska Region adopted in 2016 a ban of coal and wood as heating fuels in Krakow starting September 2019, through a specific **Municipal Regulation** (so-called anti-smog resolution). This is a radical measure for Poland and the acceptance for these new laws by the city inhabitants wouldn't be possible without the long and active engagement of initiatives such as the 'Krakow Smog Alert' and support from regional and local authorities offering subsidies up to 100% for solid fuel boilers replacement and additional assistance in covering the differences in heating costs for people affected by energy poverty.

At the beginning of 2018, less than 10,000 boilers and stoves remained in Krakow out of 24,000 counted in 2015.

For more details:

- https://powietrze.malopolska.pl/en/anti-smog-resolution/

District heating mandatory for new buildings (Upper Austria)

The Air Quality Protection and Energy Act of Upper Austria regulates the installation and use of heating systems.

Source: https://www.upperaustria.com

Since 2012 it requires new public buildings and apartment buildings including more than three apartments to be connected to a public district heating system in the case such a system is available.

In addition, cities where are quality limit values are breached might require all new apartment buildings to be connected to the district heating system. This is the case in the city of Linz.

There are exemptions for buildings with heating systems based on renewable energy and passive houses.

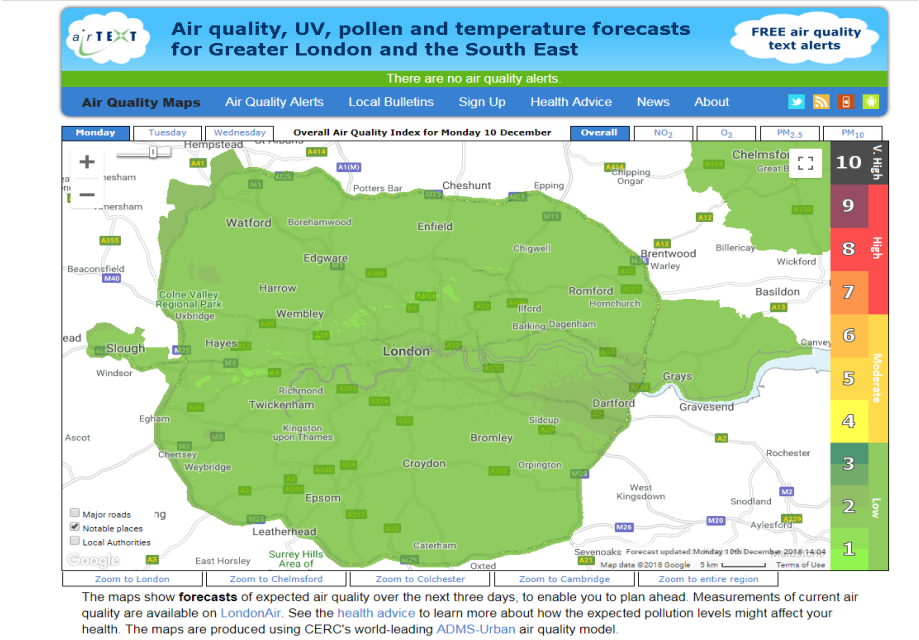
For more details:

- http://www.land-oberoesterreich.gv.at/cps/rde/xchg/ooe/hs.xsl/68293_DEU_HTML.htm
- http://www.land-oberoesterreich.gv.at/cps/rde/xchg/ooe/hs.xsl/110309_DEU_HTML.htm

CITIZENS' AWARENESS MEASURES

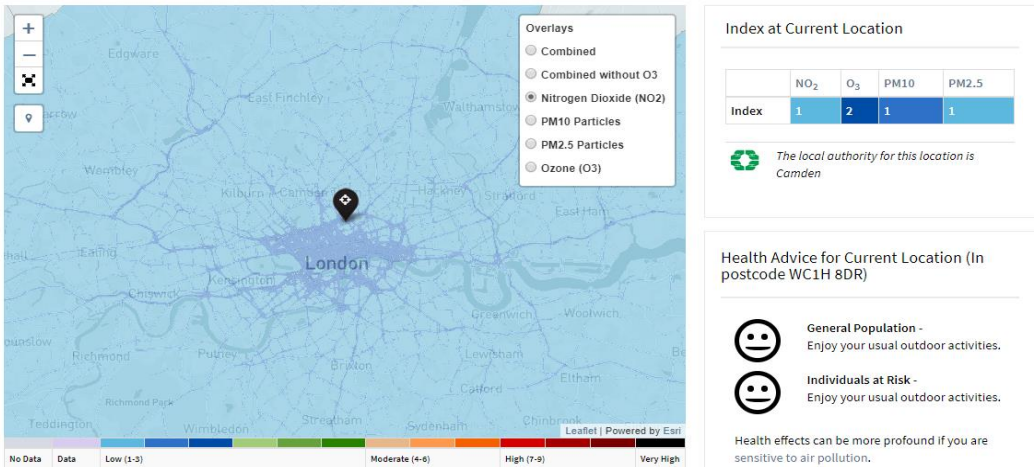
Air Quality Alert Websites (London)

A dedicated website shows maps with **forecasts** of expected air quality over the **next three days**, to enable citizens to plan ahead. It is possible to see the '**health advice**' to learn more about how the expected pollution levels might affect citizens health. The maps are produced using CERC's world-leading 'ADMS-Urban' air quality model. Free air quality alerts are available on demand on **Mobile App**.



Source: https://www.airtext.info/

Measurements of **current air quality** are available on LondonAir web site.



Source: https://www.londonair.org.uk/london

For more details:

- www.airtext.info/
- http://www.londonair.org.uk/LondonAir/Default.aspx

VI Recommendations for Air Quality Planning on Good Policies, Governance and Practices

In the following sections are reported some recommendations formulated by the cities that responded to a survey launched by the PAQ to its members in the framework of WP4 activities, which prepared Action 2 - Better Air Quality Planning (Governance).

These recommendations, fully implemented in the text of this Code, could be used for inspiration by cities in drafting, implementing and monitoring their own Air Quality Plan (AQP).

Policies

Aspects to be considered when drafting AQP

- ➔ **Complementarity of all activities defined in the AQP and those included in other relevant Planning documents of the City,** in order to obtain a positive synergistic impact and measurable
- ➔ **Complementarity with other strategic documents adopted on regional and national level**

Governance

Aspects to be considered when drafting AQP

- ➔ **Involving the Stakeholders who carry out the actual air quality measures** (e.g. procurement of **bus fleet, traffic system planning offices, tertiary system representative organizations, energy supplier agencies**) in preparation for the plan, to ensure their full implementation
- ➔ **Stakeholder/Public Consultation**
- ➔ **Looking for Political and Public support for air quality measures listed in the AQP**
- ➔ **Looking for available funding for specific measures**

ISSUES TO BE addressed in drafting AQP

SELECTION OF MEASURES TO BE ADOPTED

- ➔ Verifying if **any management/maintenance of air quality measures need to be enforced by Local Environmental Protection Agencies or National Authorities** (e.g. Large infrastructures within the boundary or in the near proximity of the City)

ISSUES TO BE addressed in MONITORING AQP

MONITORING IMPLEMENTATION OF AQP

- ➔ An important component of the process of implementation of AQP is **supervision and control** through **reports on measures implementation**, which contain a

description of measures, information on undertaken activities, performance assessment, potential issues, deviations and justification. Based on such feedback it is possible to consider the **effectiveness of the selection of measures defined in the plan** or **avoid potential problems in the development of new and/or other plans**

How to deal with Air Quality issues that cannot be solved at urban level

REGIONAL AND METROPOLITAN ISSUES

- **Involvement of Regional or Metropolitan area Organizations and Agencies** in order to better manage main emission sources (e.g. roads and highways, public transport, Local Environmental Authority)

NATIONAL ISSUES

- As far as over-regional issues are concerned **City Authorities could send communication to or look for dialogue with relevant National Ministries asking them to take action** (e.g. to amend the legislation concerning vehicle taxation and to enable regional congestion charges with the revenue directed to the region in question)
- **Lobbying Central Government** on a number of air quality issues that cannot be resolved solely at a city level (e.g. a national diesel scrappage scheme, reform to Vehicle Excise Duty, a new Clean Air Act)
- **The City Authorities could also address these issues to a National Council with representatives of cities/big cities**

INTERNATIONAL ISSUES

- **Lobbying at international level**

Tuning between cities AQP and AQP developed for other zones and agglomerations

During the development of the AQP it is important to:

- to create **co-operation between national, regional, agglomerations and cities authorities**, in areas where air quality standards are not met (crossing areas) **to meet the limit values**
- **to request opinions** on the Plan and its measures **from the neighbouring cities that belong to the Metropolitan Area**, in order to cooperate and harmonize measures
- to **align cities air quality strategy with Regional Air Quality Plans and National Air Quality Strategy, Plans and Programs**

Practices

- **Following the suggestions and source of inspiration listed in the present Code of Good Practice for Cities Air Quality Plans, which is, at present, the best Recommendation for AQ planning.**

Publication as pdf: https://ec.europa.eu/futurium/en/air-quality

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