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Report of Development of guidelines for action plans formulation for Lisbon

Deliverable B7.2

September 2021

THIS PROJECT IS FUNDED BY THE LIFE PROGRAM FROM THE EUROPEAN UNION

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SUMMARY

Guidelines for action plans formulation for Lisbon have been presented in the current document. These measures are mainly based on the implementation of the LIFE INDEX-AIR Management Tool in this city under the auspices of the LIFE INDEX-AIR project.

A number of different scenarios for air pollution emission reductions were implemented in the LIFE INDEX-AIR Management Tool to determine their effect on the air pollution concentrations, exposure and dose levels as well as on burden of decease (see Table 1).

Table 1: Emission reduction scenarios implemented in the LIFE INDEX-AIR Management Tool.

Sector		Scenario no.	Scenario code	Measure
Road traffic	Passenger cars fleet	Scenario 1	S1	To replace the no. of diesel cars to electric cars
		Scenario 2	S2	To consider all cars as electric
		Scenario 3	S3	To reduce the total no. of cars by 50%
		Scenario 4	S4	To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI
	Buses fleet	Scenario 5	S5	To change the buses fleet to EURO V (50%) and EURO VI (50%)
		Scenario 6	S6	To consider all buses as electric
Residential heating		Scenario 7	S7	To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"
		Scenario 8	S8	20% reduction of wood consumed
Cruise ships		Scenario 9	S9	To increase the number of cruises by 20%
		Scenario 10	S10	No cruises

1 Guidelines for action plans formulation for the city of Lisbon, Portugal

In the city of Lisbon the dominant source of air pollutants in the city is road traffic emissions and emissions from the port and airport. Additional important sources are residential heating and industrial emissions. The agriculture sector contributes also significantly to NH_3 emissions.

Some general recommendations for the reduction of air pollutant emissions can be proposed to the city authorities and national authorities. These recommendations can be summarized as:

Supply and demand of energy

- Increasing the renewable sources of energy
- Improvement of the energy efficiency in buildings and electric power sector

Mobility and traffic

- Improvement of the public transport network
    - Expansion of the metro system in Lisbon
    - Expansion of the buses offer (routes and number)
    - Renovation of the bus fleet
    - Renovation of the Taxis fleet
    - Increasing the peripheral car parks near interfaces
    - Restructuring the tariff and ticketing system
- In the current Low Emission Zone (LEZ)
    - Reinforcement of the requirements (Zone 1 – at least EURO 4, Zone 2 – at least EURO 3)
    - Increasing the inspection
    - Implementation of a circulation charge to Zone 1 on working days and to non-residents
- Introduction of Mobility Plans for companies that generate travel in the city of Lisbon and, in particular, in the LEZ
- Definition of mobility plans for the city
- Expansion the parking paid to the entire city of Lisbon
- Increasing inspection of paid parking in the city of Lisbon
- Renovation of the fleet of municipal solid waste collection vehicles
- Training actions on economic driving to reduce energy intensity
- Implementation of dedicated routes for cars with more than 2 passengers at peak times
- Increasing the corridors for buses in structural ways to increase commercial speed
- Increasing the frequency of street washing

- Regulation of the circulation of vehicles related to the touristic activity in the city of Lisbon
- Improvement of the measures to promote the electric mobility, with the introduction of major charging stations in the city
- Fiscal disincentive to the acquisition of vehicles with high emissions and incentive to the acquisition of electric vehicles

Harbour

- Docking only permitted to vessel with engines operating with low sulphur content
- Reducing the number of cruises

Industry

- Application of the best available techniques
- Increasing the supervision of the emissions from the industries

General

- Promotion of the urban planning policies to reduce the daily commuting
- Promotion of the good practices to reduce the atmospheric emissions of particles resulting from the construction and demolition of buildings and infrastructures
- Development of an information and communication plan on Air Quality, Environment and Mobility.
- Development of an Emergency Plan for the days in which air pollution episodes are expected.

The implementation of the different reduction emission scenarios in the city of Lisbon highlighted the priority degree of measures for the reduction of air pollution levels in the city. More specifically, the total electrification of the passenger cars (scenario S2) had the highest impact in the average PM10 and PM2.5 population exposure in both Lisbon municipality and the other municipalities of the metropolitan area of Lisbon. In Lisbon municipality, the highest relative changes for PM10 and PM2.5 population exposure were observed for working adults mainly for cars fleet scenarios (S1 – S4). Changes in the buses fleet (S5 and S6) and cruise ships (S9 and S10) have negligible effects on health impacts.

Among the modified scenarios applied to cars fleet (S1 – S4) and residential heating (S7 and S8), the elementary school children can have a reduction of the number of sick days and days of school absenteeism of up to 1000 (S1 and S2) and 200 (S1, S2 and S4), respectively

The relative change (%) in particulate matter concentration and consequent exposure, dose and deaths in Lisbon with the implementation of the different emission scenarios using the LIFE INDEX-AIR Management Tool are presented in Figures 1-5.

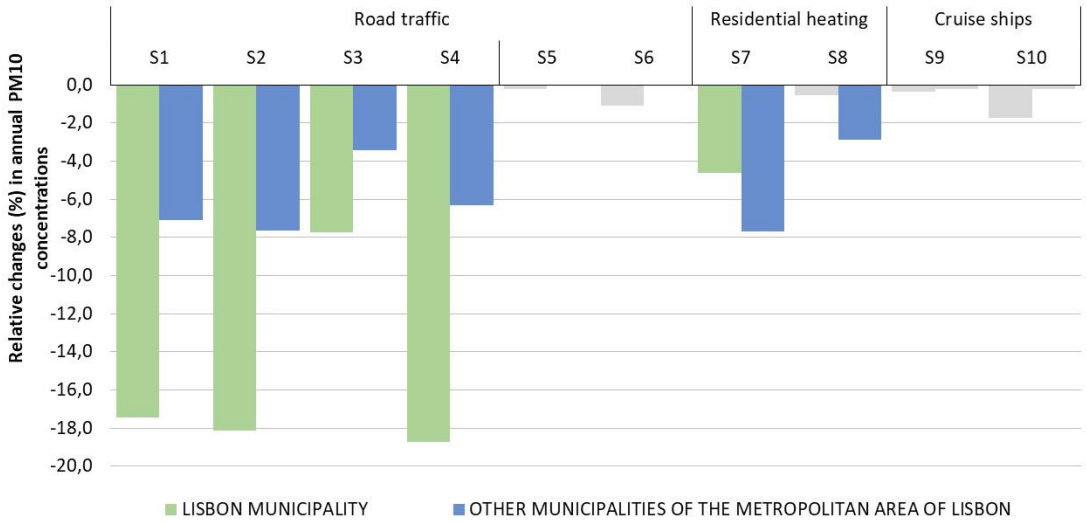

Figure 1: Relative change (%) in annual PM_{10} concentrations in the city of Lisbon.

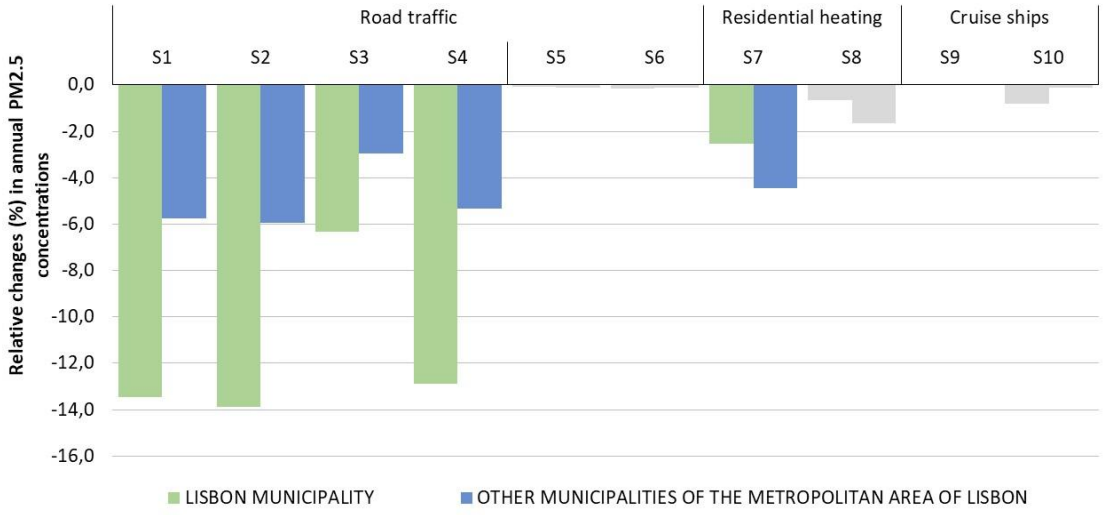

Figure 2: Relative change (%) in annual $PM_{2.5}$ concentrations in the city of Lisbon.

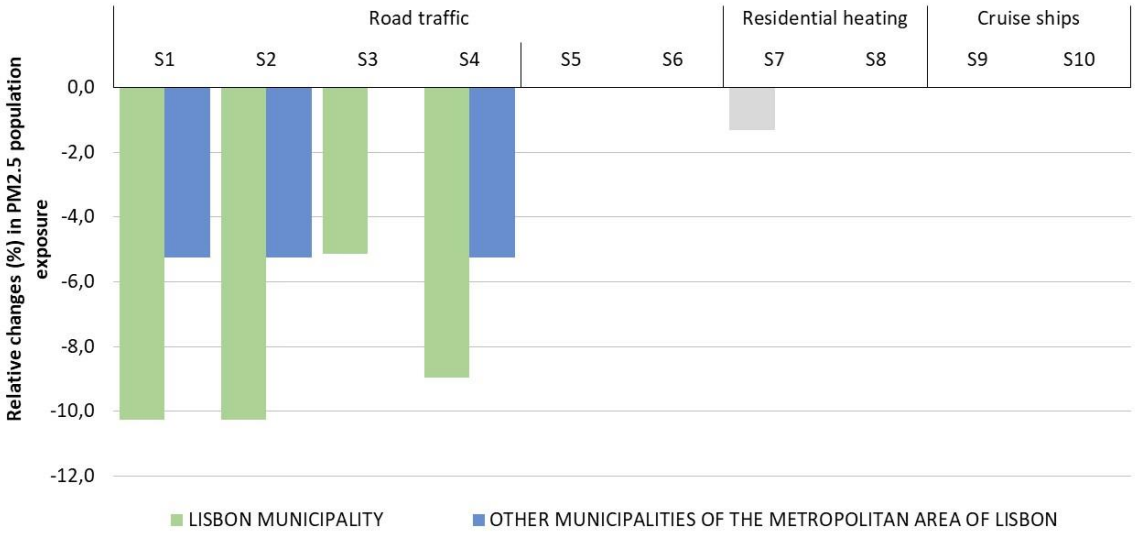

Figure 3: Relative change (%) in $PM_{2.5}$ population exposure in the city of Lisbon.

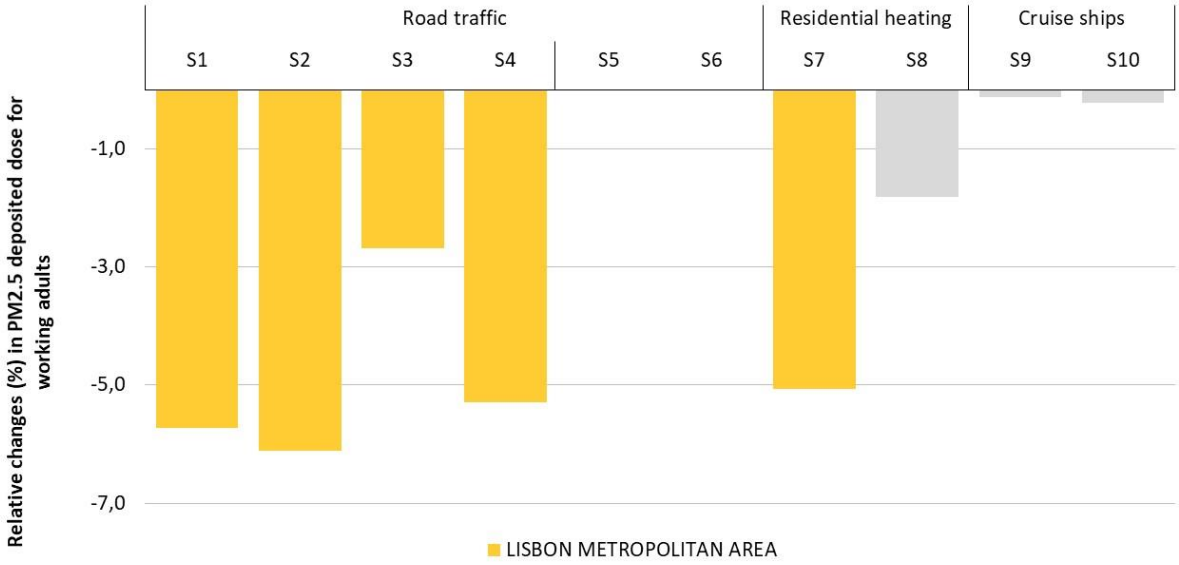

Figure 4: Relative change (%) in $PM_{2.5}$ deposited dose for working adults in the city of Lisbon.

Figure 5: Relative change (%) in deaths due to $PM_{2.5}$exposure in the city of Lisbon.

Action plan measures and priority degree for the city of Lisbon *based on the implementation of the LIFE INDEX-AIR Management Tool* are presented in Table 2.

Table 2: Action plan measures and priority degree proposed for Lisbon based on the implementation of the LIFE INDEX-AIR Management Tool.

Sector	Measure	Competence	Description	Priority
Road traffic	S1 To replace the no. of diesel cars to electric cars	National and local	Implement in city level Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S2 To consider all cars as electric	Local	Implement in city level. Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S3 To reduce the total no. of cars by 50%	Local	City measures to reduce the no of cars especially in city centre. This in combination with expansion of public transport.	
	S4 To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI	National and local	Implement further reductions in Road Tax and Import Tax for low emission vehicles (for NO2 and PM). Incentives to withdraw aged private vehicles and replacement with modern (EURO V/VI) vehicles. Installation of particle filters on heavy duty commercial vehicles.	
	S5 To change the buses fleet to EURO V (50%) and EURO VI (50%)	Local	Improvement of Public Bus Network for a resource , environmentally friendly and faster public transportation.	
	S6 To consider all buses as electric	Local	Facilitate such as measure in Municipality level with National support to improve public transport.	

Residential Heating	S7 To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"	National and local	Strict implementation of the replacement with some economical help in national / local level.	
	S8 20% reduction of wood consumed	Local	Strict implementation in local level.	

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A number of different scenarios for air pollution emission reductions were implemented in the LIFE INDEX-AIR Management Tool to determine their effect on the air pollution concentrations, exposure and dose levels as well as on burden of decease (see Table 1).

Table 1: Emission reduction scenarios implemented in the LIFE INDEX-AIR Management Tool.

Sector		Scenario no.	Scenario code	Measure
Road traffic	Passenger cars fleet	Scenario 1	S1	To replace the no. of diesel cars to electric cars
		Scenario 2	S2	To consider all cars as electric
		Scenario 3	S3	To reduce the total no. of cars by 50%
		Scenario 4	S4	To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI
	Buses fleet	Scenario 5	S5	To change the buses fleet to EURO V (50%) and EURO VI (50%)
		Scenario 6	S6	To consider all buses as electric
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		Scenario 8	S8	20% reduction of wood consumed
Cruise ships		Scenario 9	S9	To increase the number of cruises by 20%
		Scenario 10	S10	No cruises

1 Guidelines for action plans formulation for the city of Porto, Portugal

The air pollution problems in Porto result from emission sources located in the central area of the city and in the industrial belt in the north. The Porto Urban Area had in 2015 around 1 342 000 inhabitant, and is repeatedly affected by high PM concentrations. In order to comply with the air quality standards set by the current Air Quality Directive (2008/50/EU), the Northern Region of Portugal developed Air Quality Plans to reduce PM10 (CCDR–N, 2007) and NO_2 (CCDR-N, 2011). Some general recommendations for the reduction of air pollutant emissions can be proposed to the city authorities in Porto and national authorities. These recommendations can be summarized as:

Supply and demand of energy

- Certification of residential combustion equipment

- Reduction of the emissions of residential combustion (more efficient equipment)

Mobility and traffic

- Creation of High-occupancy vehicle lanes in the main access roads to Porto

- Encouraging the introduction of particulate filters in heavy goods vehicles

- Incentives for the renewal of the heavy passenger fleet

- Improvements in the collective transport network

- Promoting car sharing

- Renewal of the fleet of urban solid waste collection vehicles and taxis

- Decrease the percentage of large goods vehicles in circulation

- Construction of peripheral car parking and increase the prices of parking within Porto

- Adopting low speed limits

- Fiscalization of illegal parking

- Taxes and limitations to the entry and circulation in cities and busy areas (Low Emission Zones, Congestion Charge Zones, Differentiated Road Tolls and Alternate Circulation System based on car registrations)

-Improve frequency of street cleaning

-Introduction of public natural gas stations

Industry

- Application of the best available techniques

- Higher surveillance of industrial sources

- Substitution/implementation of high efficiency de-dusters at the industrial sources

- Inventory and improvement of the inspection of industrial areas

- Creation of emission standards for industrial areas and business activities in urban centres

General

- Conducting awareness-raising activities

- Reduction of dust during civil constructions activities

- Modification of the production process of bituminous mixtures

The implementation of the different reduction emission scenarios in the city of Porto highlighted the priority degree of measures for the reduction of air pollution levels in the city. The total electrification of the passenger cars (scenario S2) had the highest impact in the PM10 and PM2.5 concentrations in both Porto municipality and the other municipalities of the metropolitan area of Porto. The highest relative changes were observed for PM10 concentrations in Porto municipality. The PM concentration reductions obtained for cars fleet scenarios were more relevant during the winter period and less during the summer.

The modified scenarios applied to buses fleet in S6 and cruise ships (both S9 and S10) did not seem affect the average PM concentrations in both Porto municipality and other municipalities of the metropolitan area of Porto. The scenarios S5 (50% of buses are EURO V and 50% are EURO VI) and S8 (20% reduction of wood consumed) showed to have impact only on PM10 concentrations for Porto municipality. Changes in the buses fleet (S5 and S6) and cruise ships (S9 and S10) have negligible effects on health impacts (most of the values are within the range of uncertainty of the Tool). Among the modified scenarios applied to cars fleet (S1 – S4) and residential heating (S7), the elementary school children can have a reduction of the number of sick days and days of school absenteeism of up to 20 (S1, S2 and S4) and 10 (S3 and S7), respectively.

The relative change (%) in particulate matter concentration and consequent exposure, dose and deaths in Porto with the implementation of the different emission scenarios using the LIFE INDEX-AIR Management Tool are presented in Figures 1 - 5.

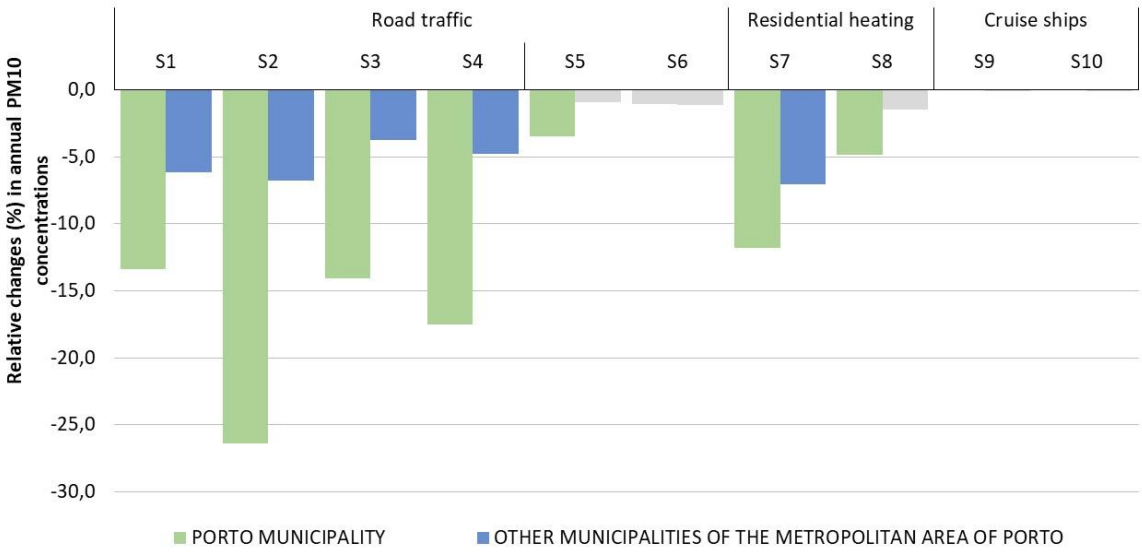

Figure 6: Relative change (%) in annual PM_{10} concentrations in the city of Porto.

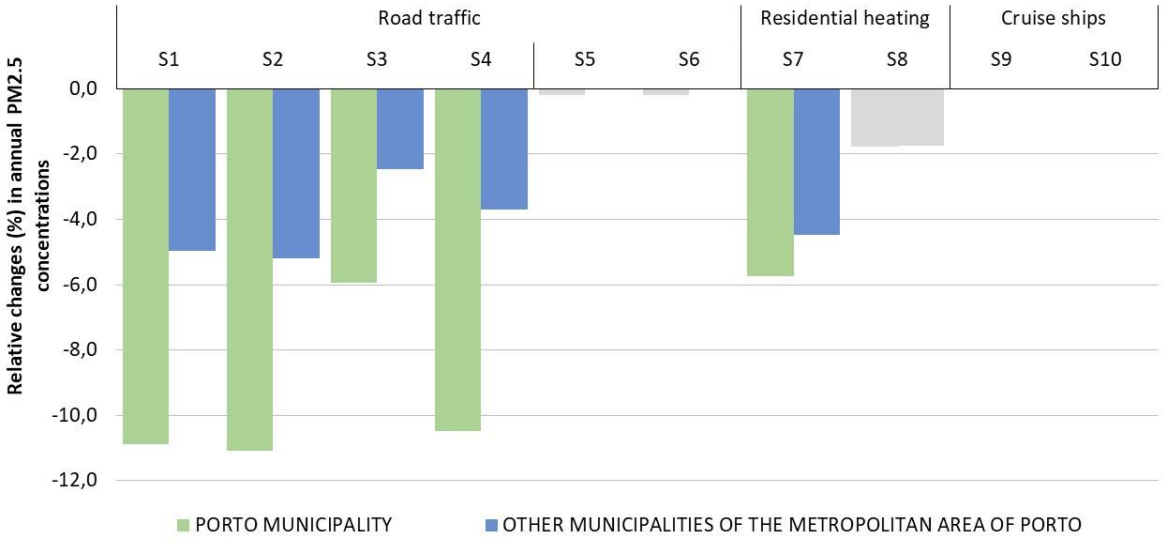

Figure 7: Relative change (%) in annual $PM_{2.5}$ concentrations in the city of Porto.

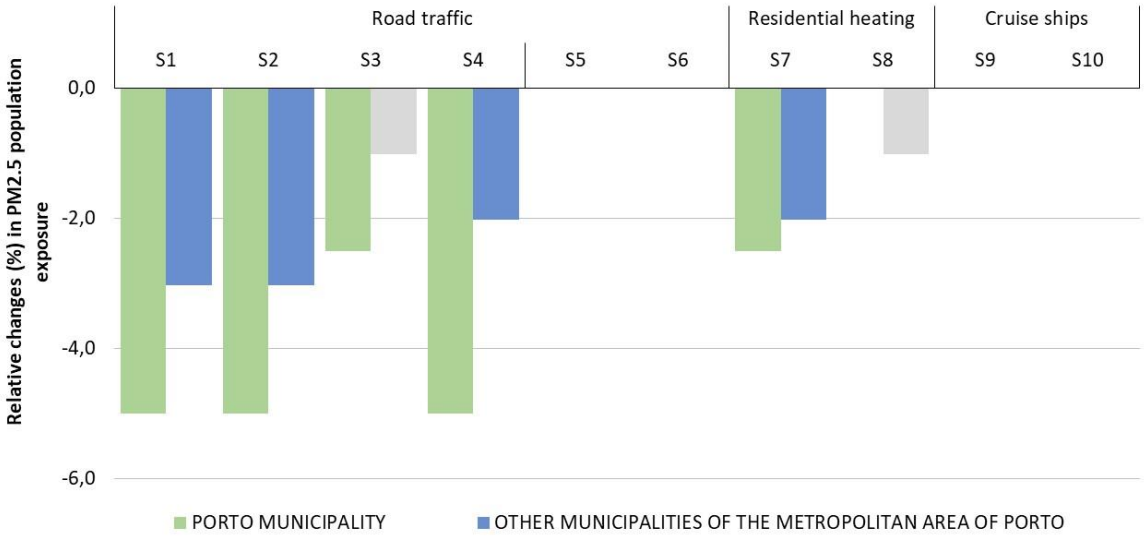

Figure 8: Relative change (%) in $PM_{2.5}$ population exposure in the city of Porto.

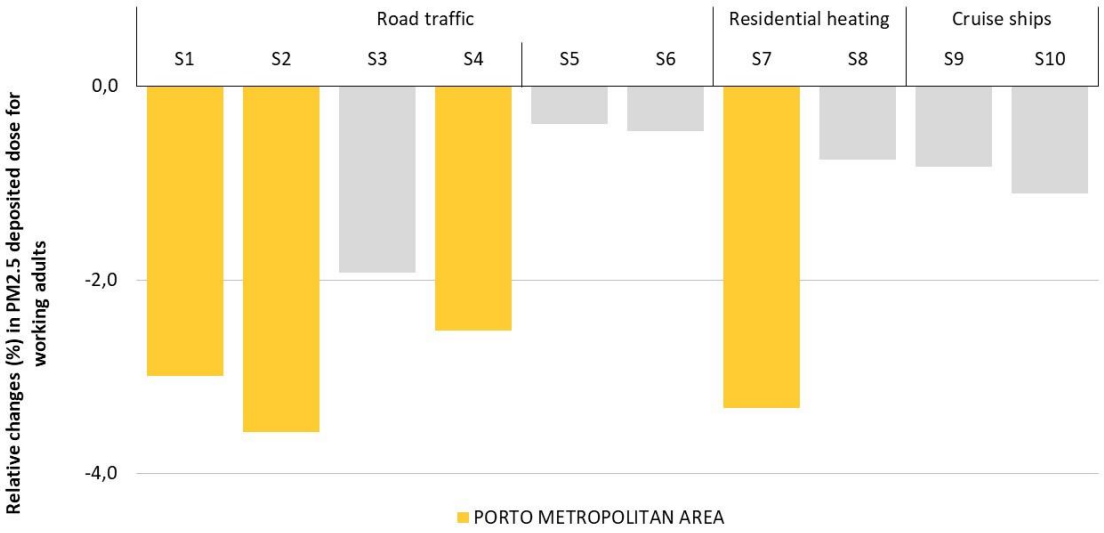

Figure 9: Relative change (%) in $PM_{2.5}$ deposited dose for working adults in the city of Porto.

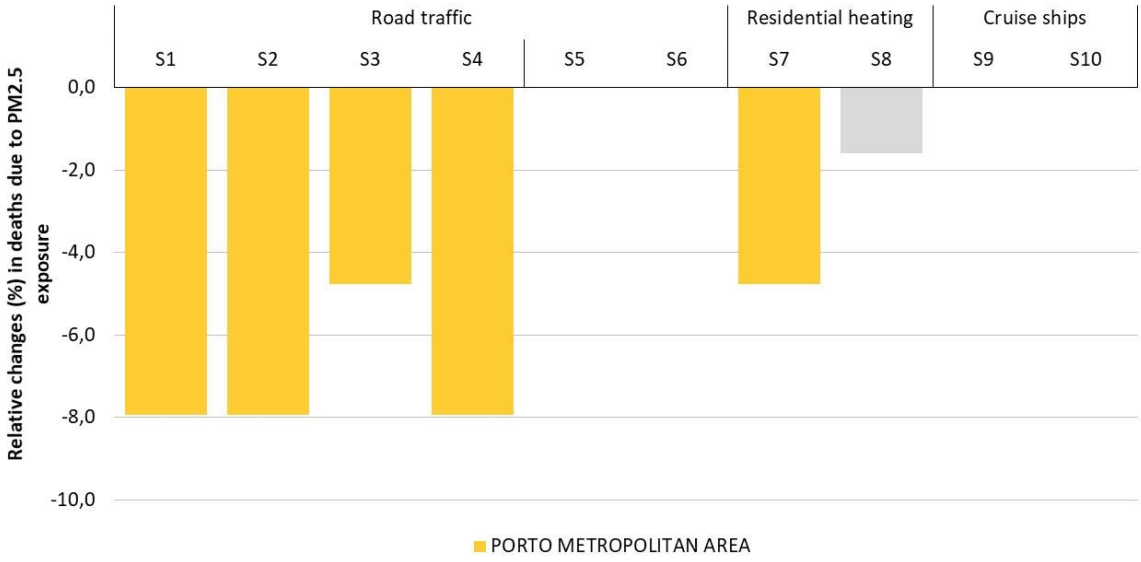

Figure 10: Relative change (%) in deaths due to $PM_{2.5}$exposure in the city of Porto.

Action plan measures and priority degree for the city of Porto *based on the implementation of the LIFE INDEX-AIR Management Tool* are presented in Table 2.

Table 2: Action plan measures and priority degree proposed for Porto based on the implementation of the LIFE INDEX-Air Management Tool.

Sector	Measure	Competence	Description	Priority
Road traffic	S1 To replace the no. of diesel cars to electric cars	National and local	Implement in city level Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S2 To consider all cars as electric	Local	Implement in city level. Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S3 To reduce the total no. of cars by 50%	Local	City measures to reduce the no of cars especially in city centre. This in combination with expansion of public transport.	
	S4 To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI	National and local	Implement further reductions in Road Tax and Import Tax for low emission vehicles (for NO_2 and PM). Incentives to withdraw aged private vehicles and replacement with modern (EURO V/VI) vehicles. Installation of particle filters on heavy duty commercial vehicles.	
	S5 To change the buses fleet to EURO V (50%) and EURO VI (50%)	Local	Improvement of Public Bus Network for a resource , environmentally friendly and faster public transportation.	
	S6 To consider all buses as electric	Local	Facilitate such as measure in Municipality level with National support to improve public transport.	

Residential Heating	S7 To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"	National and local	Strict implementation of the replacement with some economical help in national / local level.	
	S8 20% reduction of wood consumed	Local	Strict implementation in local level.	

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SUMMARY

Guidelines for action plans formulation for Athens have been presented in the current document. These measures are mainly based on local Air Quality Plans. Additional measures and identification of new ones, as well as quantification of the effects of specific measures were derived after the implementation of the Policy Tool in this city under the auspices of the LIFE INDEX-AIR project.

A number of different scenarios for air pollution emission reductions were implemented in the LIFE INDEX-AIR Management Tool to determine their effect on the air pollution concentrations, exposure and dose levels as well as on burden of decease (see Table 1).

Table 1: Emission reduction scenarios implemented in the LIFE INDEX-AIR Management Tool.

Sector		Scenario no.	Scenario code	Measure
Road traffic	Passenger cars fleet	Scenario 1	S1	To replace the no. of diesel cars to electric cars
		Scenario 2	S2	To consider all cars as electric
		Scenario 3	S3	To reduce the total no. of cars by 50%
		Scenario 4	S4	To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI
	Buses fleet	Scenario 5	S5	To change the buses fleet to EURO V (50%) and EURO VI (50%)
		Scenario 6	S6	To consider all buses as electric
Residential heating		Scenario 7	S7	To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"
		Scenario 8	S8	20% reduction of wood consumed
Cruise ships		Scenario 9	S9	To increase the number of cruises by 20%
		Scenario 10	S10	No cruises

1 Guidelines for action plans formulation for the city of Athens, Greece

The historical data on PM_{10} concentrations and exceedances of respective limit values in Athens during the last two decades show a clearly decreasing trend. This is directly or indirectly linked to the development by Greek National authorities of measures targeting mainly the mitigation of traffic emissions and the reduction of fossil fuel use due to energy efficiency improvements or interventions in favour of alternative fuels and renewable energy sources in the Athens urban agglomeration.

Source apportionment studies on PM_{10} and $PM_{2.5}$ concentrations conducted in Athens during the last years (Amato et al., 2016; Diapouli et al., 2017a) have demonstrated that the main anthropogenic sources currently responsible for the observed PM levels are vehicular traffic (with a significant contribution also from non-exhaust emissions) and biomass burning, while secondary aerosol production (secondary organic carbon and inorganic species) contribute by a large fraction to both PM_{10} and $PM_{2.5}$ concentrations as well.

Several measures related to traffic management and vehicular emission reductions have been implemented in Athens. These include an age limit of 23 years, which has been implemented for all urban, semi-urban and long distance buses. Also the limit of 11 years was set as the higher permissible age for buses in public transport. Under the provisions of the same law, economic incentives were given in the owners for the replacement of vehicles with new or used vehicles of small age. Nevertheless, efforts on the mitigation of traffic emissions must be intensified. Among the measures proposed for the city of Athens are: (i) expansion of low emission zones (LEZ); (ii) enhancement of the public transportation network and creation of large parking lots near public transport stations at the outskirts of the city, in order to promote the use of public transportation inside the city centre; (iii) increase frequency of street cleaning (especially during the dry season and African dust long-range transport events); (iv) promotion of low-carbon and low-NOx new technology vehicles and renewal of the car/taxi/motorcycle fleet, (v) reducing of road transportation for goods; (v) ensure good vehicle maintenance (effective inspection programmes for public and private vehicles); (vi) good road maintenance to reduce the contribution of PM from road surface wear.

With respect to biomass burning emissions, a significant increase has been observed during the last years in Athens, due to the extended use of wood burning for residential heating (Diapouli et al., 2017b). Efforts regarding the mitigation of this source should focus on communication / education campaigns on the “best practices”, including selection of biofuels and biomass burning appliances. In addition, economic incentives should be provided for switching to cleaner and more efficient heating methods, such as natural gas systems. Furthermore, open biomass burning (especially related to agriculture, forestry and construction) should be better regulated.

Regarding the contribution from secondary aerosol production (mainly sulphate and nitrate), mitigation strategies should focus on (i) industrial energy production; (ii) NOx traffic

emissions; (iii) NH_3 emissions resulting from agricultural, livestock and waste practices. The introduction of natural gas in the national energy system is one of the largest investments ever carried out in Greece and it constitutes a major priority of the national energy policy. Expansion projects of Greek natural gas system are under way in order to link more cities and industries to the system (e.g. Aliveri, Megalopolis, etc). Moreover, in the areas connected to the natural gas network, natural gas stations for feeding CNG (Compressed Natural Gas) vehicles have been created. Nevertheless, despite the mitigation efforts related to energy production emissions, the levels of sulphate remain high in Athens and across Greece. This may be attributed to long-range transport of SO_4^{2-} or gaseous precursors (SO_2) from outside Greece, and specifically from developing countries present in the region, which are still using high sulphur content fuels. The low oxidation rate of SO_2 to SO_4^{2-} further supports this hypothesis. It is evident, thus, that efforts on mitigating transboundary pollution in Europe should be intensified and support and incentives should be provided to developing countries to turn towards cleaner fuels and production processes.

The implementation of the different reduction emission scenarios in the city of Athens highlighted the priority degree of measures for the reduction of air pollution levels in the city. The highest relative changes for PM10 concentrations, for both Athens municipality and other municipalities of the metropolitan area of Athens, were observed for scenario S2, where all cars are considered to be electric; in this case, the annual PM10 concentration was reduced by 2.1 μg/m^3 in the Athens municipality and by 0.8 μg/m^3 in the other municipalities, in comparison to the reference case. Assuming a modified apportionment of passenger cars in terms of EURO emission standards (50% of cars are EURO V and 50% are EURO VI) (scenario S4) had the highest impact in the average PM2.5 concentrations in the Athens municipality, allowing for a reduction of the mean annual PM2.5 concentration by 1.4 μg/m^3. In respect to the burden of disease, changes in the buses fleet (S5 and S6) and cruise ships (S9 and S10) have negligible effects on health impacts. The highest impacts were observed for mitigation measures targeting the passenger car fleet, and specifically, the replacement of all diesel passenger cars by electric (S1), the total electrification of the passenger cars' fleet (S2), and the modified distribution of EURO emission standards on the fleet (50% EURO V and 50% EURO VI) (scenario S4).

The relative change (%) in particulate matter concentration and consequent exposure, dose and deaths in Athens with the implementation of the different emission scenarios using the LIFE INDEX-AIR Tool are presented in Figures 1-5.

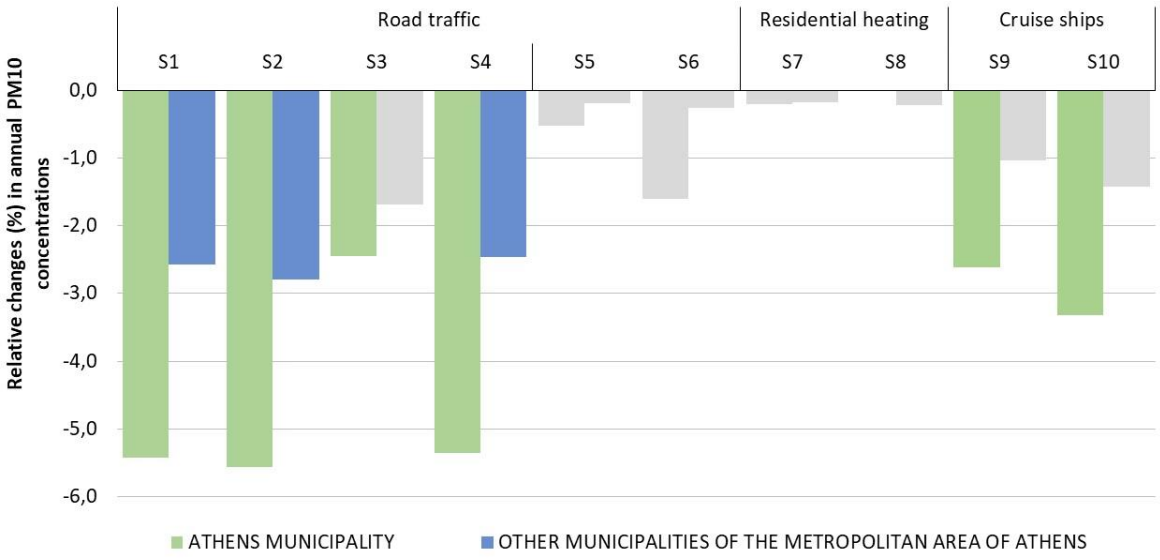

Figure 1: Relative change (%) in annual PM_{10} concentrations in the city of Athens.

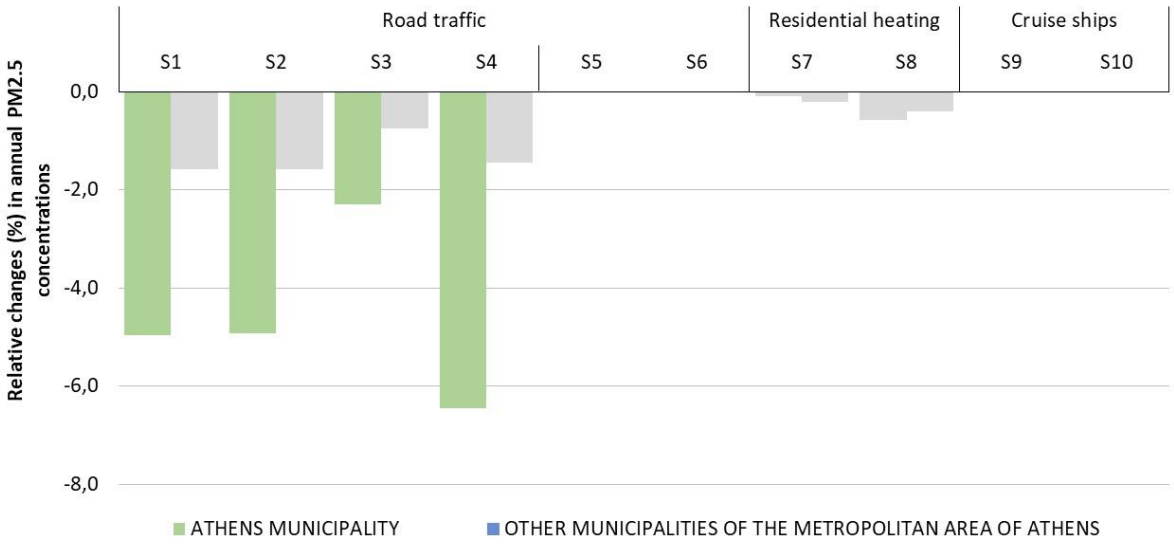

Figure 2: Relative change (%) in annual $PM_{2.5}$ concentrations in the city of Athens.

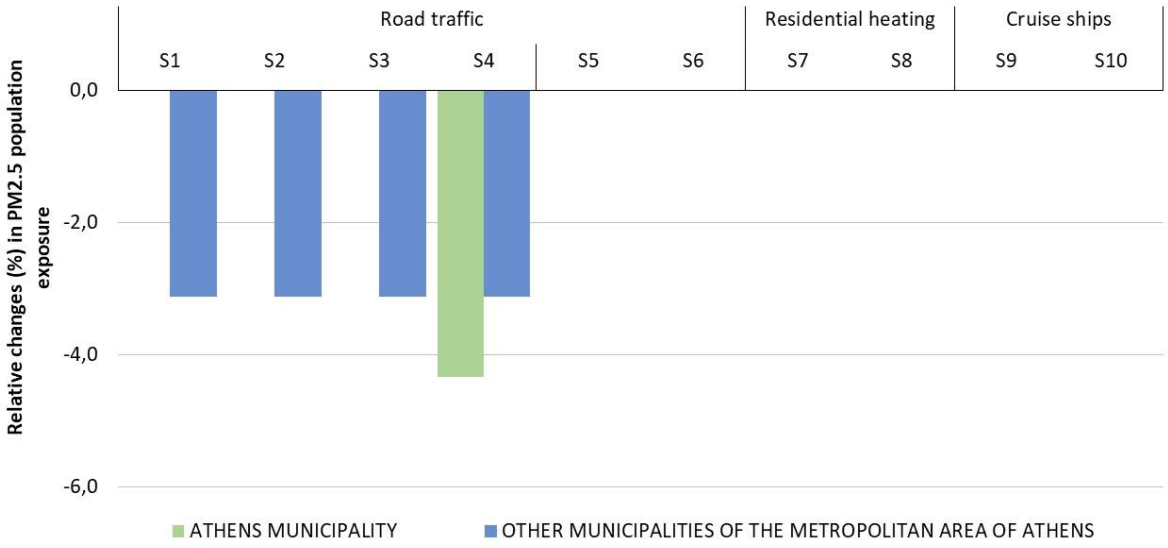

Figure 3: Relative change (%) in $PM_{2.5}$ population exposure in the city of Athens.

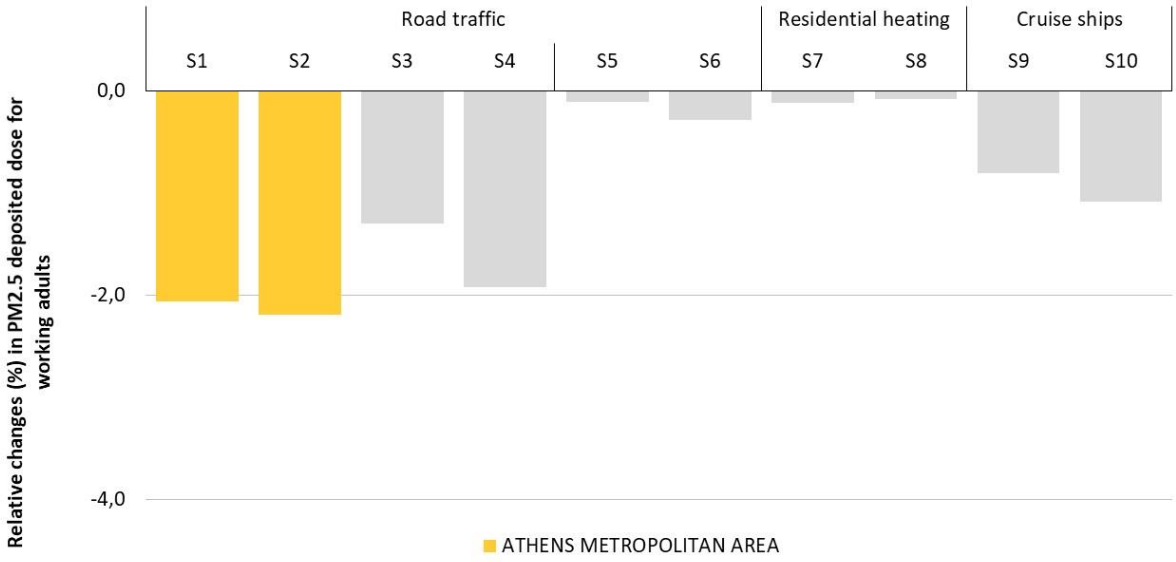

Figure 4: Relative change (%) in $PM_{2.5}$ deposited dose for working adults in the city of Athens.

Figure 5: Relative change (%) in deaths due to $PM_{2.5}$exposure in the city of Athens.

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Table 2: Action plan measures and priority degree proposed for Athens based on the implementation of the LIFE INDEX-AIR Management Tool.

Sector	Measure	Competence	Description	Priority
Road traffic	S1 To replace the no. of diesel cars to electric cars	National and local	Implement in city level Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S2 To consider all cars as electric	Local	Implement in city level. Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S3 To reduce the total no. of cars by 50%	Local	City measures to reduce the no of cars especially in city centre. This in combination with expansion of public transport.	
	S4 To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI	National and local	Implement further reductions in Road Tax and Import Tax for low emission vehicles (for NO2 and PM). Incentives to withdraw aged private vehicles and replacement with modern (EURO V/VI) vehicles. Installation of particle filters on heavy duty commercial vehicles.	
	S5 To change the buses fleet to EURO V (50%) and EURO VI (50%)	Local	Improvement of Public Bus Network for a resource, environmentally friendly and faster public transportation.	
	S6 To consider all buses as electric	Local	Facilitate such as measure in Municipality level with National support to improve public transport.	

Residential Heating	S7 To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"	National and local	Strict implementation of the replacement with some economical help in national / local level.	
	S8 20% reduction of wood consumed	Local	Strict implementation in local level.	

References

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Report of Development of guidelines for action plans formulation for Kuopio

Deliverable B7.2

September 2021

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TÉCNICO LISBOA · universidade de aveiro · Technical University of crete · DEMOKRITOS NATIONAL CENTRE FOR SCIENTIFIC RESEARCH · NATIONAL INSTITUTE FOR HEALTH AND WELFARE

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SUMMARY

Guidelines for action plans formulation for Kuopio have been presented in the current document. These measures are mainly based on the implementation of the LIFE INDEX-AIR Management Tool in this city under the auspices of the LIFE INDEX-AIR project.

A number of different scenarios for air pollution emission reductions were implemented in the LIFE INDEX-AIR Management Tool to determine their effect on the air pollution concentrations, exposure and dose levels as well as on burden of decease (see Table 1).

Table 1: Emission reduction scenarios implemented in the LIFE INDEX-AIR Management Tool.

Sector		Scenario no.	Scenario code	Measure
Road traffic	Passenger cars fleet	Scenario 1	S1	To replace the no. of diesel cars to electric cars
		Scenario 2	S2	To consider all cars as electric
		Scenario 3	S3	To reduce the total no. of cars by 50%
		Scenario 4	S4	To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI
	Buses fleet	Scenario 5	S5	To change the buses fleet to EURO V (50%) and EURO VI (50%)
		Scenario 6	S6	To consider all buses as electric
Residential heating		Scenario 7	S7	To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"
		Scenario 8	S8	20% reduction of wood consumed
Cruise ships		Scenario 9	S9	To increase the number of cruises by 20%
		Scenario 10	S10	No cruises

1 Guidelines for action plans formulation for the city of Kuopio, Finland

The main local emission sources of air pollutants are road traffic and residential combustion, especially in areas without central district heating. Long-range transport contributes largely to concentrations of fine particulate matter. Street dust in springtime raises concentrations of particulate matter due to traction sand and studded tires, which are used during winters. In the spring when snow and ice have melted and streets dried, dust particles are released to air, worsening the air quality.

The city of Kuopio does not have yet its own air quality plan and does not identified yet mitigation measures for air quality. Identified measures for the air quality plan for Helsinki for 2017-2024 have been proposed here as possible relevant measures to be adopted also in the city of Kuopio. The themes of the Plan are the factors with a significant impact on air quality: (1) traffic, (2) street dust and (3) small-scale combustion of wood.

1. Traffic
   - 1.1. Implementation of vehicle traffic pricing is being investigated and promoted
     Effective way to reduce the amount of traffic and streamlining the remaining traffic. Reducing the amount of vehicle traffic effectively reduces climate emissions as well as noise.
   - 1.2. Developing bus fleet in order to reduce emissions
     In order to become more environmentally friendly bus fleet is being developed and for instance use of electric busses is being investigated. Diesel buses are being adapted to use renewable waste-based biofuels. Introduction of hybrid and electric buses will also reduce noise.
   - 1.3. Low-emission zones environmental zones
     The environmental zone limits the emissions generated by busses and waste collection vehicles in the city centre. Adherence to tighter emissions restrictions is required in the environmental zone.
   - 1.4. Parking pricing
     Parking pricing is raised in order to reduce traffic in the inner city, especially during rush hours.

2. Road dust
   - 2.1. Active dust binding and more effective street cleaning methods
   - 2.2. Targeted gritting and effective sand removals
     Gritting will be reduced whilst taking care to ensure that it does not endanger safety. Washed sifted and durable crushed stone will be favored for gritting.
   - 2.3. Dust prevention on large construction sites
     The City is working together with construction firms and subcontractors in order to ensure dust prevention on the sites.
   - 2.4. Reduction of dust from railways

3. Wood combustion
    3.1. Communicating ways and impacts of reduction of emissions from wood stoves
    3.2. Promoting good methods for wood storing
    3.3. Promoting low-emission sauna stoves
    3.4. Improving monitoring of smoke and providing advices to reduce the harm

The implementation of the different reduction scenarios in the city of Kuopio using the LIFE INDEX-AIR Management Tool resulted to interesting results. More specifically, the highest reduction of PM_{10} exposures were achieved with residential heating scenarios (S7 and S8) ranging from -15% among pre-school children to -22% among working adults. Replacing diesel passenger cars with electric cars resulted to PM_{10} reduction of -3.1%, -6.7% and -2% among all groups, working adults and elderly, respectively. In other municipalities residential heating scenarios resulted in around 50 to 60 % reduction of PM_{10} exposures among all groups. Interestingly residential heating scenarios (S7-S8) were the only measures that was estimated to benefit the health of elementary school children.

The relative change (%) in particulate matter concentration and consequent exposure, dose and deaths in Kuopio with the implementation of the different emission scenarios using the LIFE INDEX-AIR Management Tool are presented in Figures 1-5.

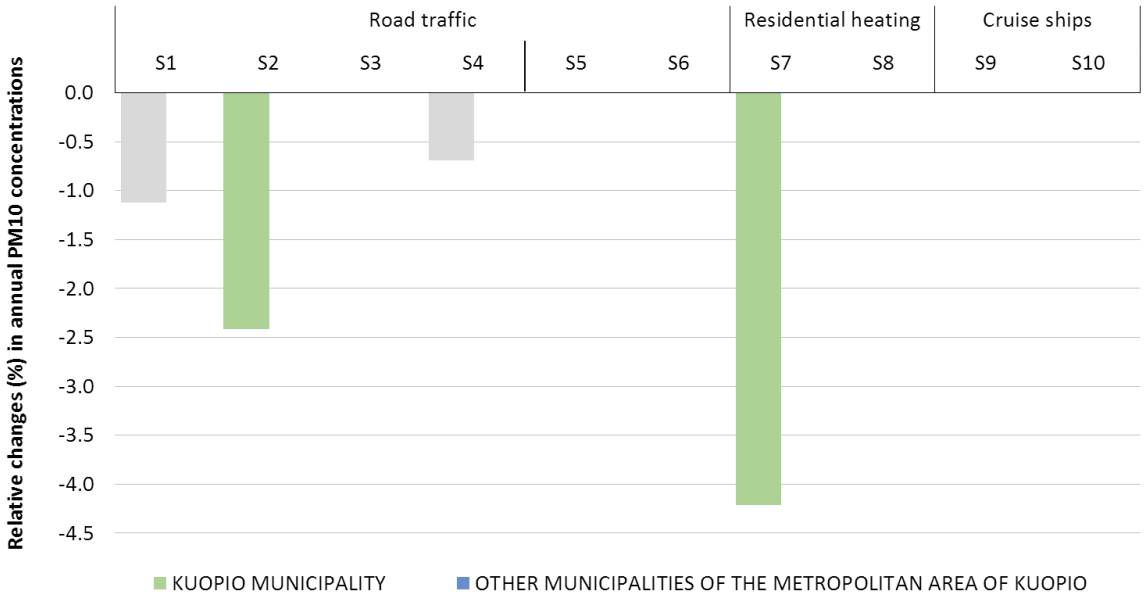

Figure 1: Relative change (%) in annual PM_{10} concentrations in the city of Kuopio.

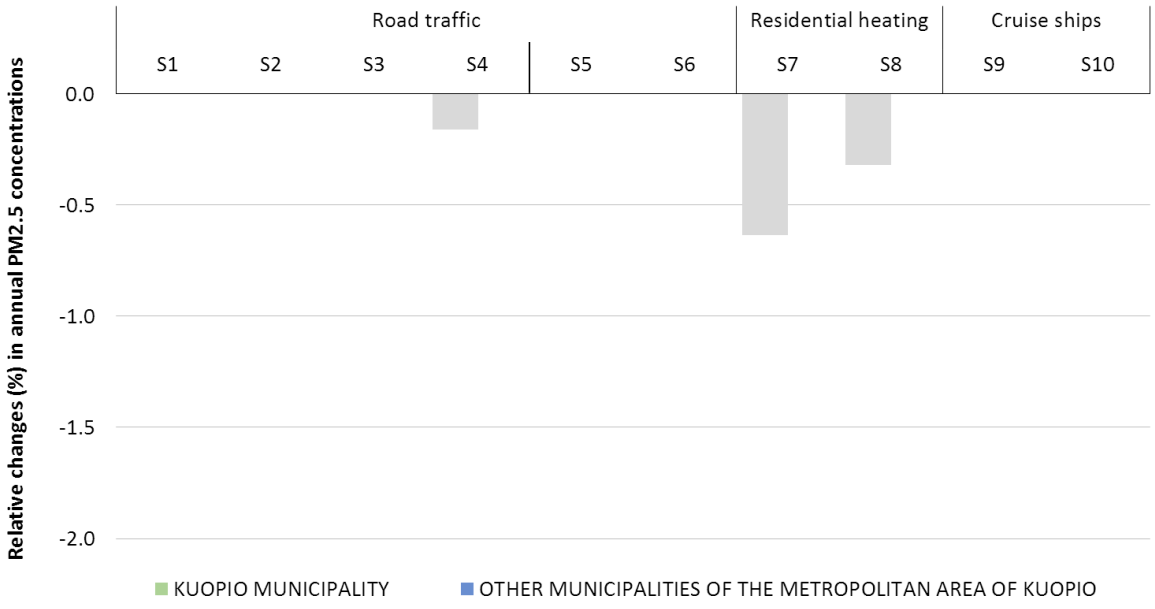

Figure 2: Relative change (%) in annual $PM_{2.5}$ concentrations in the city of Kuopio.

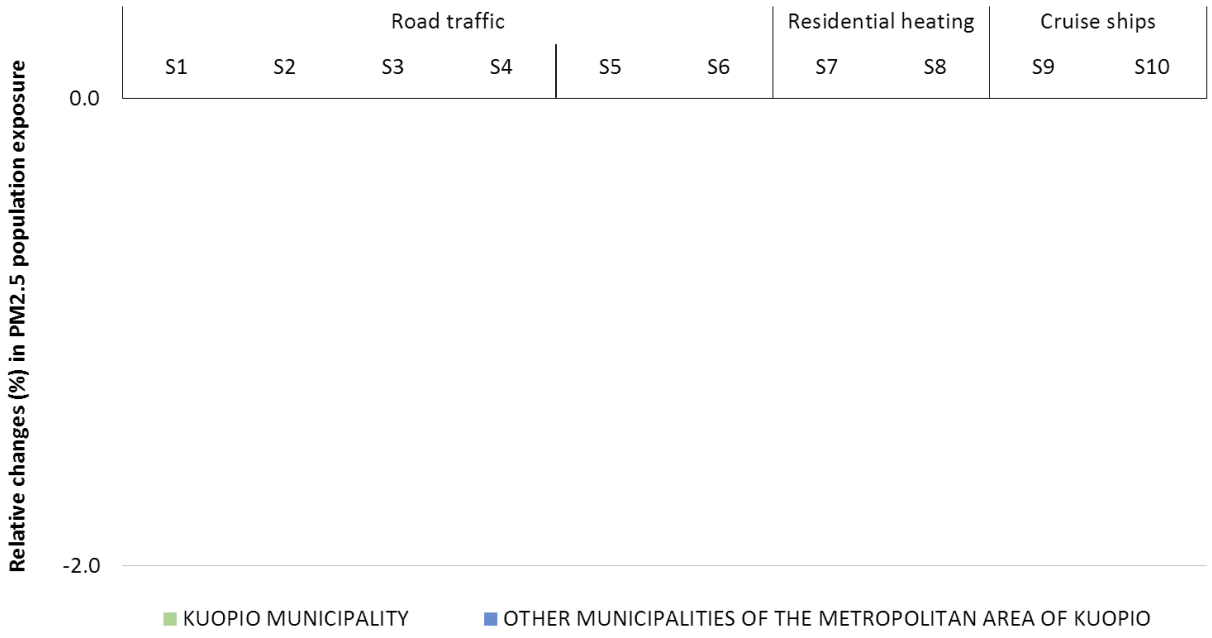

Figure 3: Relative change (%) in $PM_{2.5}$ population exposure in the city of Kuopio.

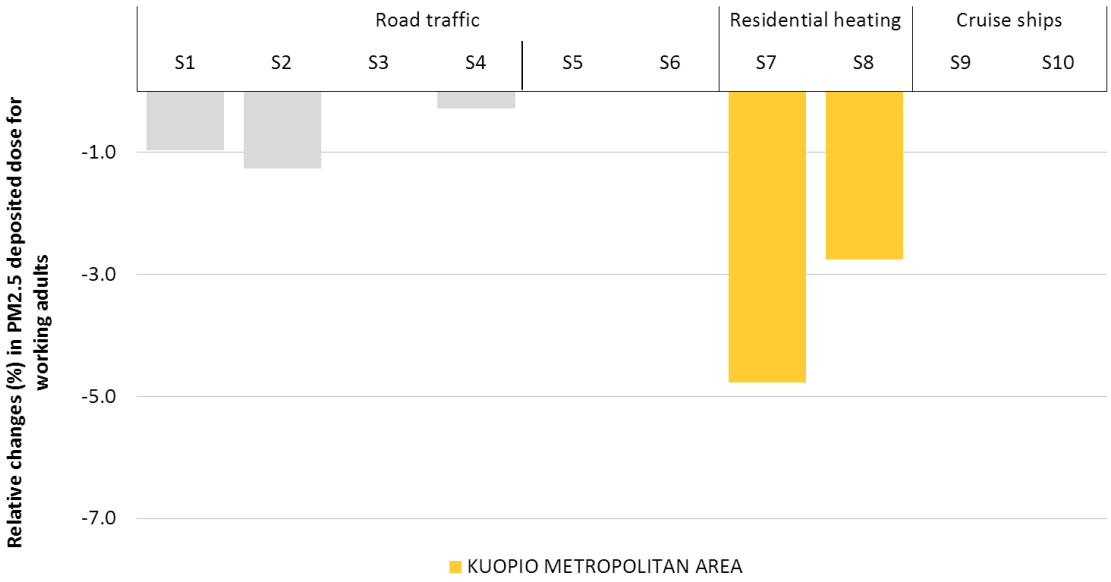

Figure 4: Relative change (%) in $PM_{2.5}$ deposited dose for working adults in the city of Kuopio.

Figure 5: Relative change (%) in deaths due to $PM_{2.5}$exposure in the city of Kuopio.

Action plan measures and priority degree for the city of Kuopio *based on the implementation of the LIFE INDEX-AIR Management Tool* are presented in Table 2.

Table 2: Action plan measures and priority degree proposed for Kuopio based on the implementation of the LIFE INDEX-AIR management Tool.

Sector	Measure	Competence	Description	Priority
Road traffic	S1 To replace the no. of diesel cars to electric cars	National and local	Implement in city level Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S2 To consider all cars as electric	Local	Implement in city level. Expand and prioritise the unlimited access for electric and hybrid low emission in city Centre. Consider reductions in parking fees.	
	S3 To reduce the total no. of cars by 50%	Local	City measures to reduce the no of cars especially in city centre. This in combination with expansion of public transport.	
	S4 To remove the cars from EURO I, II, III and IV - > 50% of cars are EURO V and 50% are EURO VI	National and local	Implement further reductions in Road Tax and Import Tax for low emission vehicles (for NO2 and PM). Incentives to withdraw aged private vehicles and replacement with modern (EURO V/VI) vehicles. Installation of particle filters on heavy duty commercial vehicles.	
	S5 To change the buses fleet to EURO V (50%) and EURO VI (50%)	Local	Improvement of Public Bus Network for a resource, environmentally friendly and faster public transportation.	
	S6 To consider all buses as electric	Local	Facilitate such as measure in Municipality level with National support to improve public transport.	

Residential Heating	S7 To replace inefficient devices (Fireplaces, Woodstove and Salamander Stove) for "More Efficient Fireplaces"	National and local	Strict implementation of the replacement with some economical help in national / local level.	
	S8 20% reduction of wood consumed	Local	Strict implementation in local level.	

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1 Guidelines for action plans formulation for the city of Treviso, Italy

In the city of Treviso main sources of air pollutants in addition to vehicle traffic and house emissions are many small and medium size production companies such as mechanical field, textile, furniture, construction and paper milling. The agriculture sector was also the largest source of NH_3 and the non-industrial combustion plants sector was the largest source of SO_2, particulate matter and metals. The solvent and other product use sector was the largest source of VOC and the road transport sector was the largest source of NOx.

Concerning the implementation of the *LIFE INDEX-AIR Management Tool* and the scenarios used for the reduction of emissions of air pollutants, the reduction (%) of health impacts due to exposure to $PM_{2.5}$ was more effective for the scenarios related to the reduction of emissions related to residential heating. The most important scenarios (with the highest reduction) for Treviso Metropolitan area are the residential heating scenarios (S7 & S8) while the impact/reduction of road traffic scenarios is negligible. The highest reduction was observed for disability adjusted life years (DALY). Specifically, scenarios S7 and S8 decrease DALY by 49.8% and 46.6 %, respectively.

The relative change (%) in particulate matter concentration and consequent exposure, dose and deaths in Treviso with the implementation of the different emission scenarios using the INDEX-AIR Tool are presented in Figures 1 - 5.

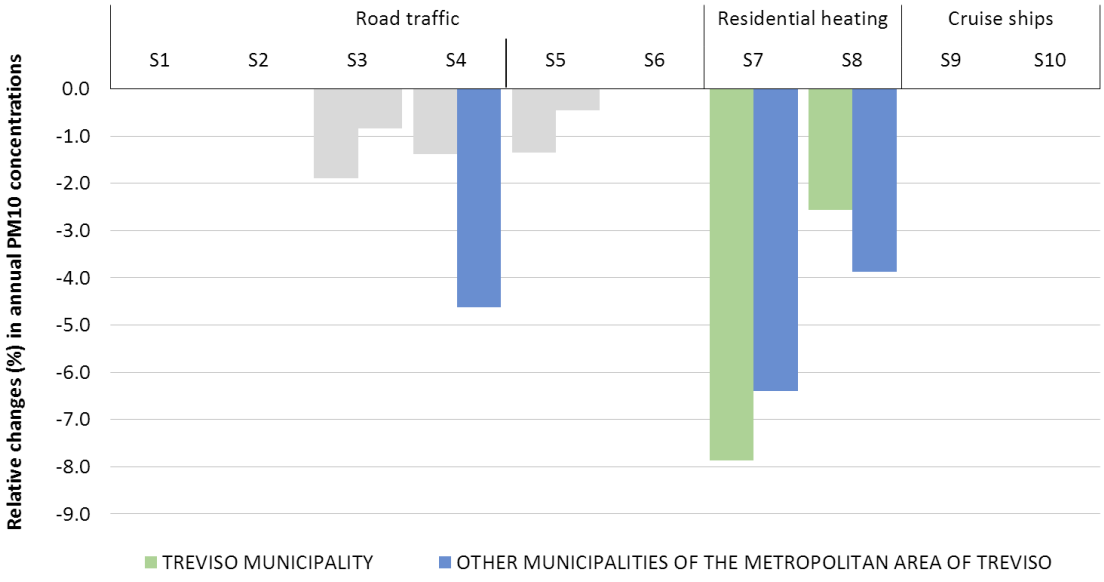

Figure 1: Relative change (%) in annual PM_{10} concentrations in the city of Treviso.

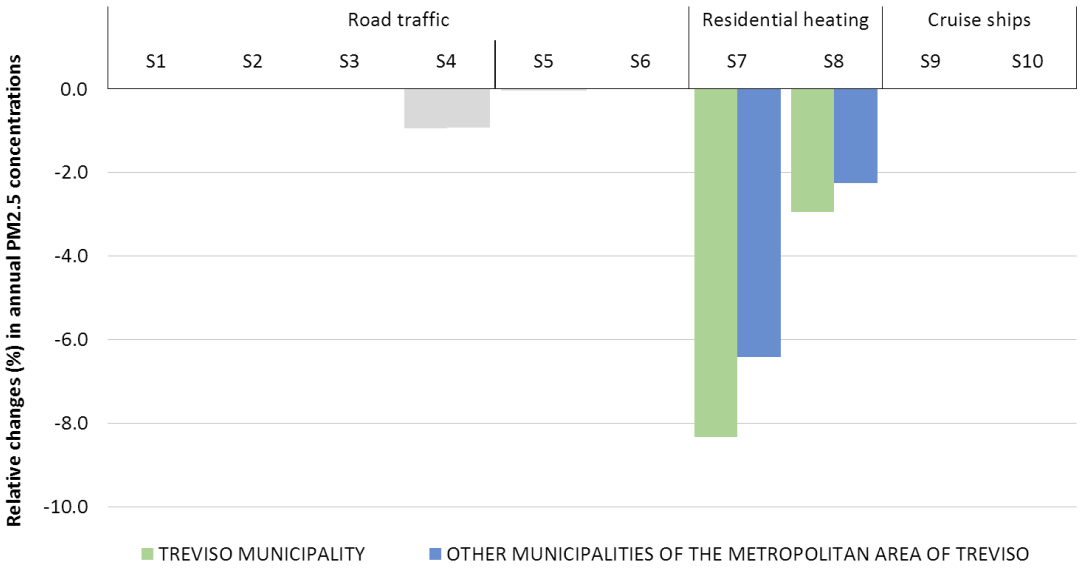

Figure 2: Relative change (%) in annual $PM_{2.5}$ concentrations in the city of Treviso.

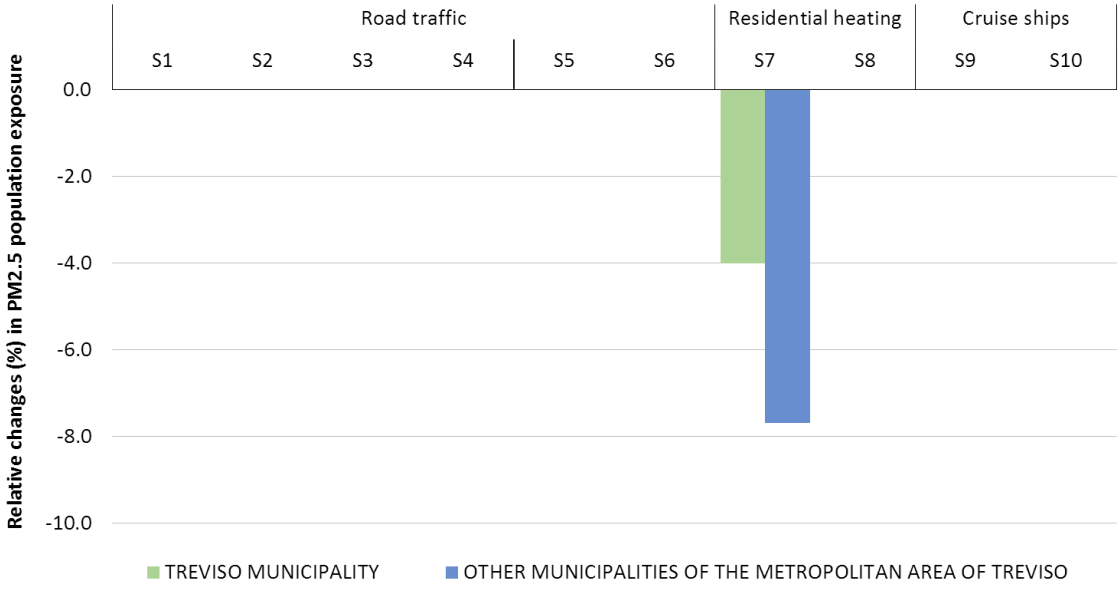

Figure 3: Relative change (%) in $PM_{2.5}$ population exposure in the city of Treviso.

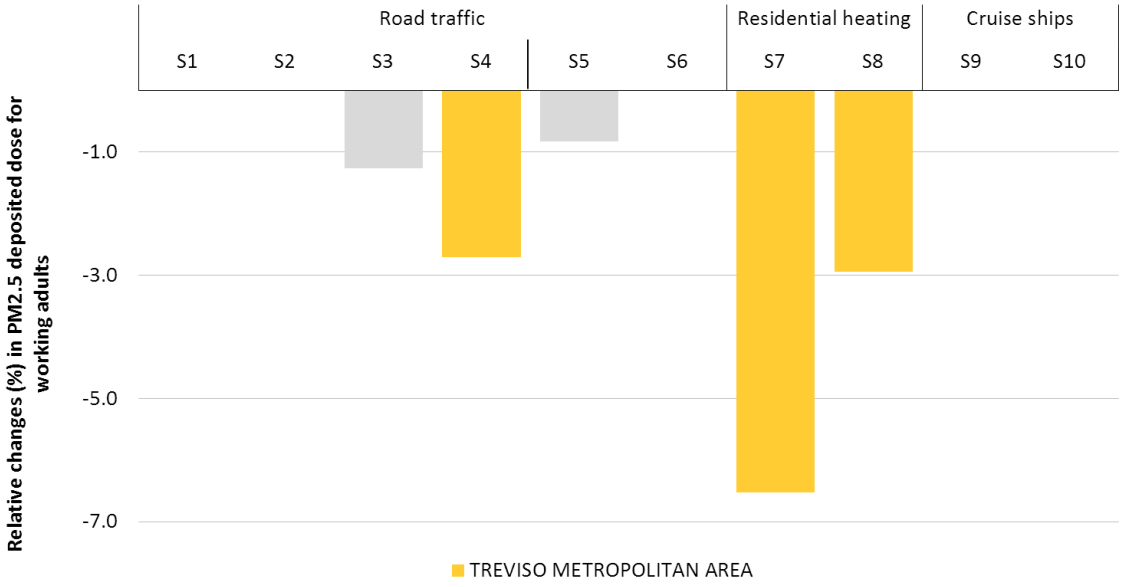

Figure 4: Relative change (%) in $PM_{2.5}$ deposited dose for working adults in the city of Treviso.

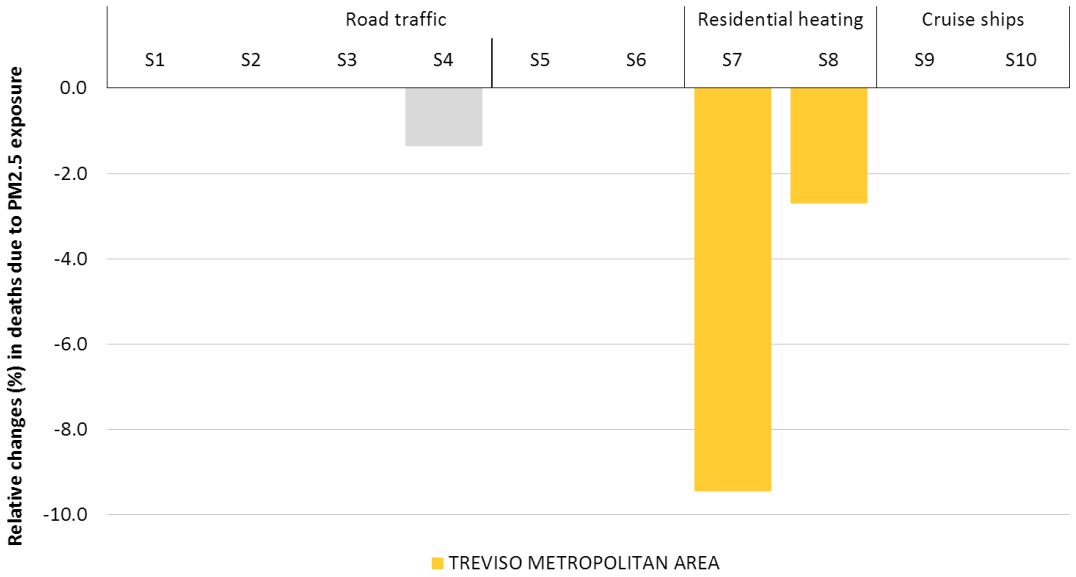

Figure 5: Relative change (%) in deaths due to $PM_{2.5}$exposure in the city of Treviso.

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