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Scenario dispersion and exposure calculations of NO_2 for 2010, 2015, and 2020 for Oslo

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Summary

Commissioned by the Norwegian Pollution Control Authority (SFT), NILU has performed dispersion and exposure calculations for 2010, 2015, and 2020 to evaluate the concentration and exposure levels with respect to the National Air Quality Target and EU guidelines for NO_2. In a previous report, a baseline development for both PM_{10} and NO_2 was calculated. These calculations did not reflect recent year's trends in the concentration level of NO_2. This scenario describes a slightly different development of NO_2-emissions and the resulting changes in concentrations and exposure.

By applying the model system AirQUIS (AirQUIS, 2007) ambient concentrations of NO_2 have been computed for Oslo. Based on projections of both emissions and regional background concentrations from a reference year (2005), scenario calculations for 2010, 2015, and 2020 have been performed. These simulations include exposure calculations in order to indicate the expected exceedance levels for the various years.

Ambient air concentrations and population exposure have been calculated both in the positions of buildings located close to the main road network, and within a two-dimensional grid with a quadratic 1 km^2 grid size.

The total number of inhabitants exposed beyond the National Target and EU guideline for NO_2 for the baseline simulations for 2010, 2015, and 2020 are summarized below in Table A (original baseline) and Table B (scenario).

Table A: Exposure results with respect to the National target and the EU guidelines for NO_2, original baseline. Values in brackets indicate the portion of the population exposed in building points.

	No. of people exposed, 9th highest hourly value beyond 150 µg/m^3	**No. of people exposed, 19th highest hourly value beyond 200 µg/m^3**	**No. of people exposed to Yearly average beyond 40µg/m^3**
Reference 2005	652 (652)	26 (26)	2825 (2825)
Baseline 2010	4321 (4321)	43 (43)	15422 (15422)
Baseline 2015	522 (522)	0	4373 (4373)
Baseline 2020	179 (179)	0	2055 (2055)

Table B: Exposure results with respect to the National target and the EU guidelines for NO_2, scenario. Values in brackets indicate the portion of the population exposed in building points.

	No. of people exposed, 9th highest hourly value beyond 150 μg/m^3	**No. of people exposed, 19th highest hourly value beyond 200 μg/m^3**	**No. of people exposed to Yearly average beyond 40μg/m^3**
Scenario 2010	146 257 (43 718)	1559 (1559)	98 804 (41 641)
Scenario 2015	150 032 (51 227)	2073 (2073)	114 073 (47 340)
Scenario 2020	150 443 (56 006)	2012 (2012)	104 381 (51 359)

In the original calculations a reduction in concentrations and hence the population weighted average are calculated from 2010 to 2020. Only a few people are exposed beyond the hourly limit values of the national target and the EU guidelines for 2020, whereas a slightly higher percentage of the population live in areas where exceedances of the yearly average limit value are expected. In the scenario, the changes in vehicle composition and oxidation rate of NO_X leads to an increase in concentrations, and thus in exposure values. The increase in level of exposure stagnates around 2015, with the introduction of Euro 6 class vehicles and a stagnation in the growth of long range transport of ozone.

Scenario dispersion and exposure calculations of NO_2 for 2010, 2015, and 2020 for Oslo

1 Introduction

Commissioned by the Norwegian Pollution Control Authority (SFT), NILU has performed dispersion and exposure calculations for NO_2 for Oslo for the years 2010, 2015, and 2020. The computed concentration levels have been compared with the limit values defined in the National Air Quality Target and EU guidelines. Calculations have been performed by applying the model system AirQUIS (AirQUIS, 2007). In a previous report (NILU OR 56/2007), a baseline development for both PM_{10} and NO_2 was calculated. These (baseline) calculations did not reflect recent year's trends in the concentration level of NO_2. The new scenario describes a slightly different development of NO_2-emissions and the resulting changes in concentrations and exposure.

Ever since the introduction of the 3-way catalyst, emissions of NO_X from vehicles have been steadily reduced. The emission limitations in the Euro class regulations have ensured that this trend continues. However, the emission limitations concern NO_X, and the observed development in NO_2 concentrations both in Norway and in Europe does not correspond to the emission reduction of NO_X. The main reason is believed to be an increase in primary NO_2 emissions from vehicles. The baseline and scenario calculations show that minor changes in the basis for calculating vehicular emissions can maintain the same NO_X-emissions while radically increase the NO_2-emissions.

Both the local emissions and the regional background concentrations have been projected towards 2010, 2015, and 2020 from a reference year (2005). The calculations for 2010, 2015, and 2020 apply meteorological input data from the reference year (2005).

The concentration levels of NO_2 are calculated only for the winter season. The yearly average has been estimated using a scaling factor from the winter mean to the annual mean, based on measured concentrations for the reference year.

Ambient air concentrations and population exposure have been calculated both in the positions of buildings, located close to the main road network, and within a two-dimensional grid with a quadratic 1 km^2 grid size.

This report focus on the changes in emission calculation assumptions and the resulting differences in concentration development and compares it to the baseline calculations.

2 Description of the model calculations

The AirQUIS modelling system developed by NILU is applied in this study to calculate concentrations of NO_2 (AirQUIS, 2007). AirQUIS is a GIS based integrated management system that includes a user interface, comprehensive measurement and emission inventory databases, and a suite of models for use in simulating ambient air concentrations and exposure. For a further description, see NILU OR 56/2007. The system is also described in Slørdal et al., 2008.

2.1 Reference calculation for the year 2005

In a previous project NILU has carried out PM_{10} and NO_2 calculations for Oslo for the year 2005 (Slørdal et al., 2006b). The results from these calculations have been applied as the reference basis for making the 2010, 2015, and 2020 projections. A detailed description of the calculations for the year 2005 has been given in the report ”Dispersion and exposure calculations of PM_{10}, NO_2, and Benzene for Oslo and Trondheim for the year 2005” (Slørdal et al., 2006b), and the reader is referred to this report for further information.

The original (baseline) projection for 2010, 2015 and 2020 is described in details in NILU OR 56/2007 (Laupsa et al.).

2.2 Scenario projection for 2010, 2015 and 2020.

With the reference 2005 model setup as starting point, the emissions and the regional background concentrations have been projected towards 2010, 2015, and 2020. All other model settings are identical to those applied in the reference 2005 simulations, e.g. meteorology and population.

Based on this updated emission inventory and background concentrations, baseline concentrations and exposure simulations for 2010, 2015, and 2020 have been performed.

2.2.1 Emission projections

2.2.1.1 Traffic data

In the project ”Tiltaksutredning i Osloregionen etter forskrift om lokal luftkvalitet med forslag til handlingspakker”, projected traffic data were constructed for Oslo for the year 2015 (Oslo kommune/Statens vegvesen Region øst, 2004). These data were applied in the 2010, 2015, and 2020 baseline calculations. The road network, vehicle composition, road classifications, speed limits, road slope, etc. were the same for all the three calculation years. The only differences were in traffic emission factors and annual daily traffic (ADT).

For 2010 the ADT prognosis was taken as 90% of the 2015 ADT. The same scaling was applied for all roads. According to the most updated prognosis from the Norwegian Public Roads Administration, the ADT in 2020 was increased by 9% relative to 2015 (personal communication, Kjell Johansen). (Appendix B)

A growth in vehicles with un-studded tyres from 76 % in 2005 to 85 % in 2010 has been implemented. However, no change has been expected in the use of un-studded tyres between 2010 and 2020 (Appendix B).

The traffic emission factors in the baseline calculations was updated according to a prognosis from the Institute of Transport Economics (Johansen, K.W., 2003), Statistics Norway (Kjetil Flugsrud, personal communication), the European

Environmental Agency (EEA, 2006) and a draft report from the Air Quality Expert group results (2006) (Appendix B). The scenario emission factors was calculated taking into account the sales statistics of 2006 and 2007 for passenger vehicles, which show a marked change towards diesel powered engines. Also a small change in the exchange rate for heavy duty vehicles was made, keeping a larger fraction of the oldest emission class. Finally, the percentage of NO_2 in NO_X for heavy duty vehicles was changed from an "average" estimate (15 %) to a "high" estimate (30 % up to and including Euro 4, 60 % for Euro 5 and Euro 6). The percentage of NO_2 in NOx for light duty vehicles remains the same as in the baseline calculations. The changes in vehicle class composition from the baseline calculations to the scenario calculations are shown in Table 1. The resulting changes in average vehicle emissions due to change in composition and oxidation rate for NO_X and NO_2 are shown in Table 2.

Table 1: Changes from the baseline (B) to the scenario (S) for vehicle class composition. Unit is % of vehicle class (of light and of heavy).

	Vehicle type	**2010**	**2015**	**2020**
Light duty	B euro 4 g	16,5	12,2	7,4
	S euro 4 g	12,5	9,0	5,5
	B euro 4 d	5,1	3,4	2,0
	S euro 4 d	9,1	6,6	3,9
	B euro 5 g	14,2	29,7	21,2
	S euro 5 g	8,3	17,3	12,2
	B euro 5 d	4,2	8,7	5,9
	S euro 5 d	10,1	21,1	14,9
	B euro 6 g	0	11,2	39,3
	S euro 6 g	0	6,7	23,4
	B euro 6 d	0	3,7	12,6
	S euro 6 d	0	8,2	28,5
Heavy duty	B euro1	5,7	1,9	0,2
	S euro 1	9,7	3,6	0,8
	B euro3	12,1	4,2	1,2
	S euro 3	8,1	2,5	0,6

Table 2: Changes in average vehicle emissions of NO_X and NO_2 from the baseline to the scenario calculations (unit: g/vkm).

Year	**2010**	**2015**	**2020**
Baseline NO_X	1,009	0,646	0,483
Scenario NO_X	1,036	0,660	0,486
Baseline NO_2	0,138	0,091	0,069
Scenario NO_2	0,231	0,206	0,184

As can be seen from the table, the difference in average emissions for NO_X between the baseline and the scenario is rather small, while the difference in the emission of NO_2 is large and increases from 2010 to 2020. The emission scenario is in line with the general expectations for future development of NO_X emissions, but it describes a new trend for NO_2 emissions.

2.2.2 Projections of the regional background (boundary conditions).

Measured hourly and/or daily data of ozone and NO_2 for 2005 have been scaled (in percentage) according to EMEP predictions for the Oslo area for 2010, 2015, and 2020 (Appendix B).

3 Exposure results for 2010, 2015 and 2020.

The calculated dispersion and exposure results have been evaluated against the National Air quality targets and the European Guidelines (Table 3).
As a part of the evaluation the population weighted average concentration has been calculated for the model domain. This number is defined as,

$$C_{PWA} = \frac{1}{N}\sum_{m=1}^{M}\overline{C}_m n_m \quad ; \qquad (1)$$

where *M* is the sum of all grid cells and building points (here M = 22 x 18 + total number of building points), n_m is the number of people in each of the m grid cells or building points, *N* is the total population within the modelling area, i.e., $N = \sum_{m=1}^{M} n_m$, and $\overline{C}_m$ is the mean concentration in each grid cell or building point *m*. Note that for the grid cells, the applied n_m is the rest population after having subtracted the people living in the building points within the grid cell.

As an additional exposure quantity the population weighted average exceedance has also been calculated. This quantity is defined as

$$C_{PWAE} \equiv \frac{1}{N}\sum_{m=1}^{M}\left(\overline{C}_m - C_T\right)n_m \qquad (2)$$

where C_T is the threshold (limit) value considered and the other variables are as defined in (1). In the expression (2) only positive contributions from the terms $\overline{C}_m - C_T$ are considered.

C_{PWA} is thus a measure of the average concentration level experienced by the population, whereas C_{PWAE} is a related measure of the average exceedance level for the total population within the modelling domain.

The total number of inhabitants exposed beyond the "National Target" and EU guidelines for NO_2 for the baseline simulations for 2010, 2015, and 2020 are summarized in Table 4. The population weighted average (C_{PWA}) and population weighted average exceedances (C_{PWAE}) are calculated for national target values and EU guidelines (Table 5). The corresponding results for the scenario calculations are shown in Table 6 and Table 7.

Table 3: The National air quality targets and the European guidelines for NO_2.

National target NO_2	**EU guidelines NO_2**
Hourly values of 150 µg/m^3 NO_2,not to be exceeded more than 8 times a calendar year	Hourly values of 200 µg/m^3 NO_2, not to be exceeded more than 18 times a calendar year
	Year:40 µg/m^3 NO_2

Table 4: Exposure results with respect to the National target and the EU guidelines for NO_2. Values in brackets indicate the portion of the population exposed in building points.

	No. of people exposed, 9th highest hourly value beyond 150 µg/m^3	**No. of people exposed, 19th highest hourly value beyond 200 µg/m^3**	**No. of people exposed to Yearly average beyond 40µg/m^3**
Reference 2005	652 (652)	26 (26)	2 825 (2825)
Baseline 2010	4321 (4321)	43 (43)	15 422 (15 422)
Baseline 2015	522 (522)	0	4 373 (4373)
Baseline 2020	179 (179)	0	2 055 (2055)

Table 5: The population weighted average (C_{PWA}) and the population weighted average exceedances (C_{PWAE}) with respect to the National target and the EU guidelines for NO_2.

	9th highest daily value 150µg/m^3	**19th highest daily value 200µg/m^3**	**Yearly average 40µg/m^3**
Reference 2005	95.3/171.3	89.2/242.7	16.6/43.4
Oslo Baseline 2010	105.1/159.6	98.1/214.9	19.1/44.2
Oslo Baseline 2015	99.0/161.4	92.6/-	16.5/44.1
Oslo Baseline 2020	94.3/158.5	88.4/-	14.8/43.2

Table 6: Exposure results with respect to the National target and the EU guidelines for NO_2 for the scenario. Values in brackets indicate the portion of the population exposed in building points.

	No. of people exposed, 9th highest hourly value beyond 150 µg/m³	**No. of people exposed, 19th highest hourly value beyond 200 µg/m³**	**No. of people exposed to Yearly average beyond 40µg/m³**
Reference 2005	652 (652)	26 (26)	2 825 (2825)
Scenario 2010	146 257 (43 718)	1559 (1559)	98 804 (41 641)
Scenario2015	150 032 (51 227)	2073 (2073)	114 073 (47 340)
Scenario 2020	150 443 (56 006)	2012 (2012)	104 381 (51 359)

Table 7: The population weighted average (C_{PWA}) and the population weighted average exceedances (C_{PWAE}) with respect to the National target and the EU guidelines for NO_2 for the scenario.

	9th highest daily value 150µg/m³	**19th highest daily value 200µg/m³**	**Yearly average 40µg/m³**
Reference 2005	95.3/171.3	89.2/242.7	16.6/43.4
Scenario 2010	125.5/167.7	117.0/221.3	24.9/45.5
Scenario 2015	127.8/169.2	119.7/220.8	25.0/45.6
Scenario 2020	127.4/168.5	119.7/221.1	24.7/46.0

In the original calculations a reduction in concentrations and hence the population weighted average are calculated from 2010 to 2020. Only a few people are exposed beyond the hourly limit values of the national target and the EU guidelines for 2020, whereas a slightly higher percentage of the population live in areas where exceedances of the yearly average limit value are expected. In the scenario, the changes in vehicle composition and oxidation rate of NO_X leads to an increase in concentrations, and thus in exposure values. The increase in level of exposure stagnates around 2015, with the introduction of Euro 6 class vehicles and a reduction in the growth of long range transport of ozone.

4 Concentration maps related to the National Target and EU guidelines for NO_2.

Concentration maps of NO_2 for 2010, 2015, and 2020 showing various percentile concentration levels are presented in this section. In addition to the concentration fields, the figures also indicate (by black dots) the building points, where exceedances are calculated according to the National Target values and the EU guidelines. For the corresponding figures for the baseline calculations it is referred to Laupsa et al., 2007.

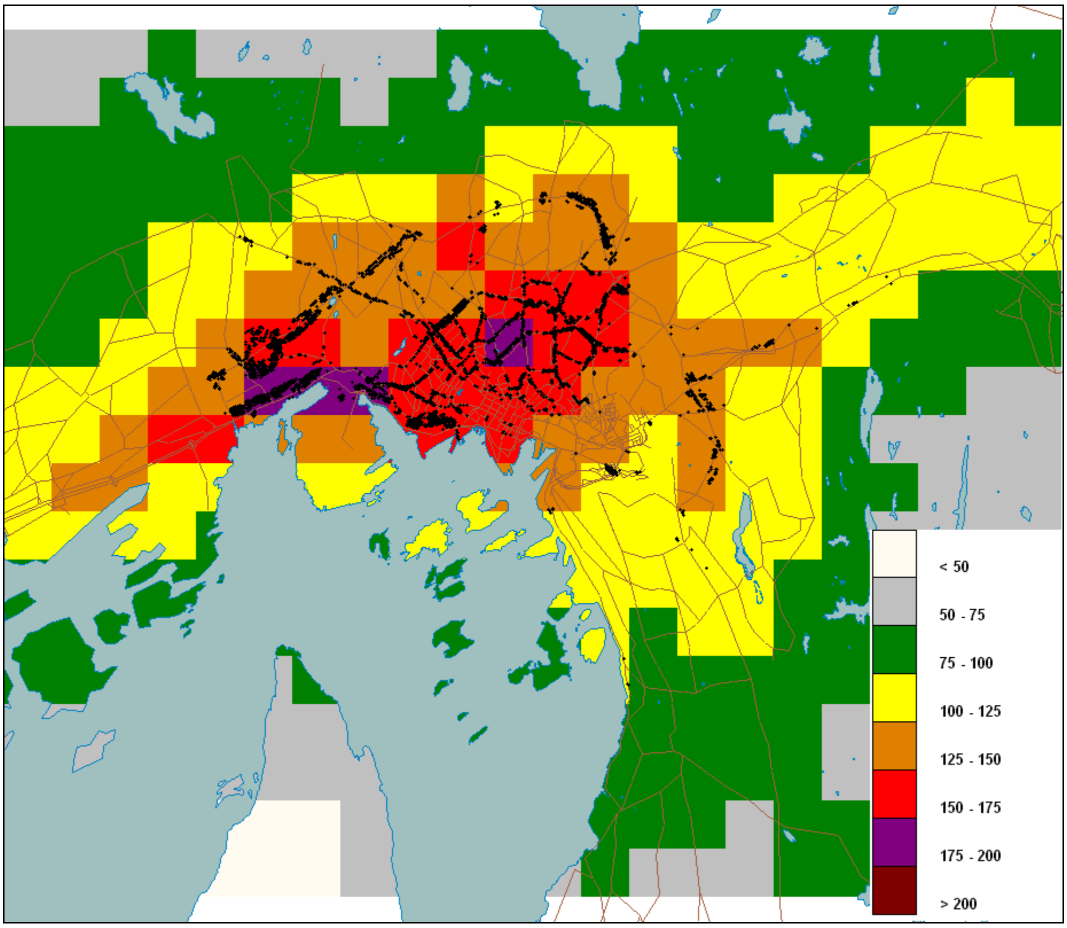

Figure 1: Projection of the 9th highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2010. The black dots are illustrating the building points where the 9th highest daily NO_2 value is above limit value of 150 $\mu g/m^3$.

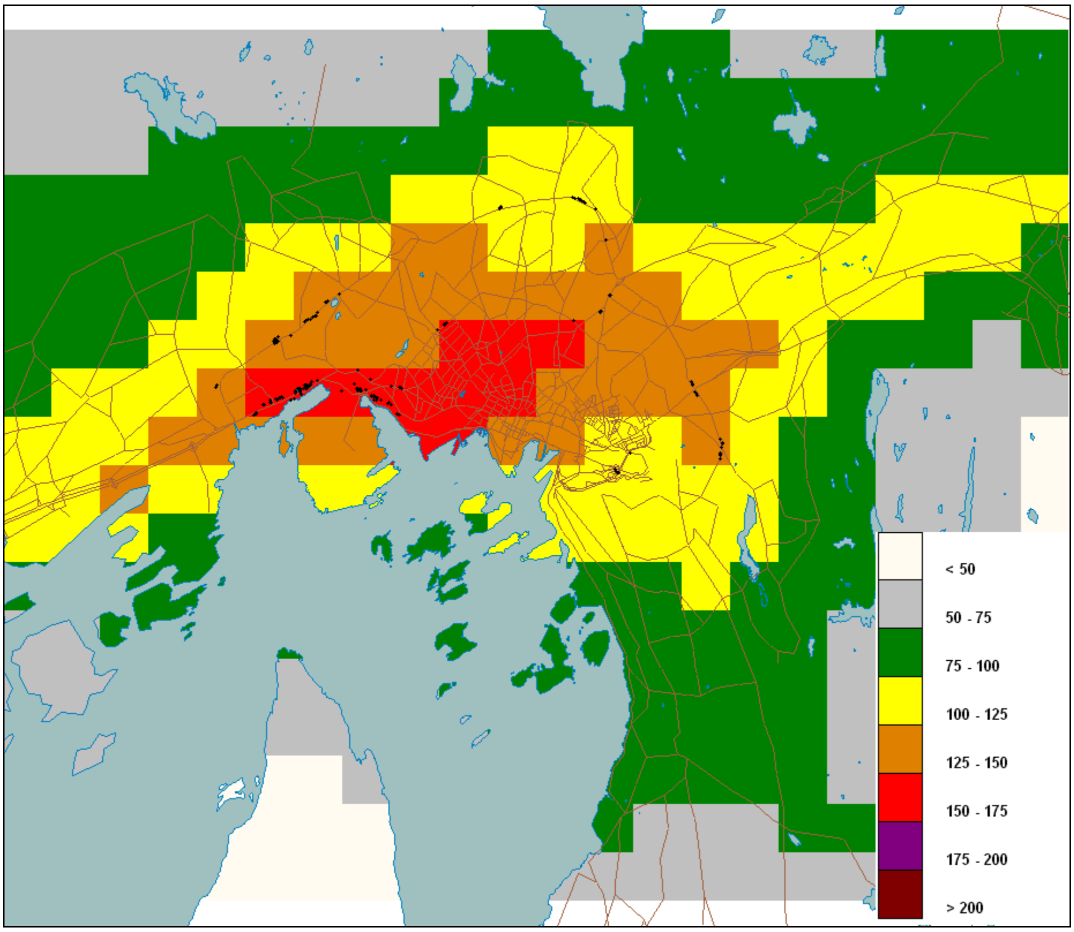

Figure 2: Projection of the 19th highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2010. The black dots are illustrating the building points where the 19th highest daily NO_2 value is above limit value of 200 $\mu g/m^3$.

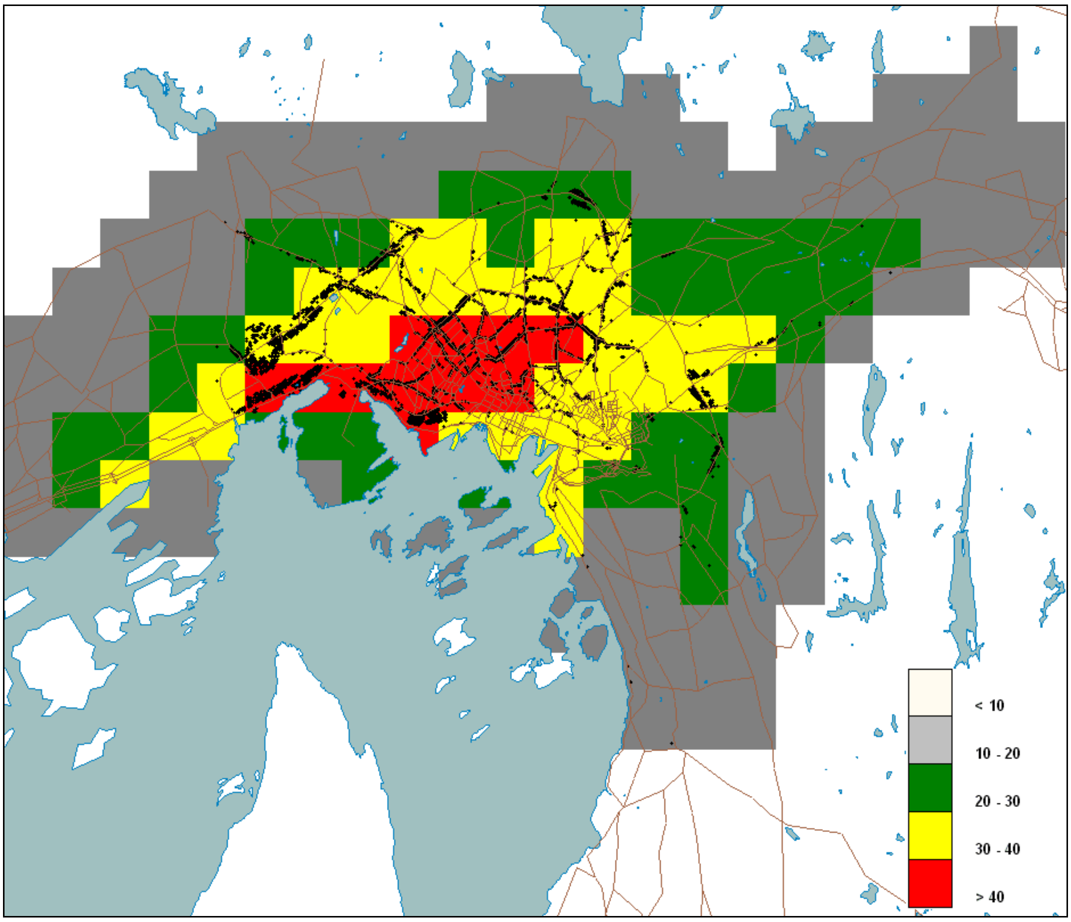

Figure 3: Projection of the yearly grid value (EU) of NO_2 ($\mu g/m^3$) for 2010. The black dots are illustrating the building points where the yearly value of NO_2 is above limit value of 40 $\mu g/m^3$.

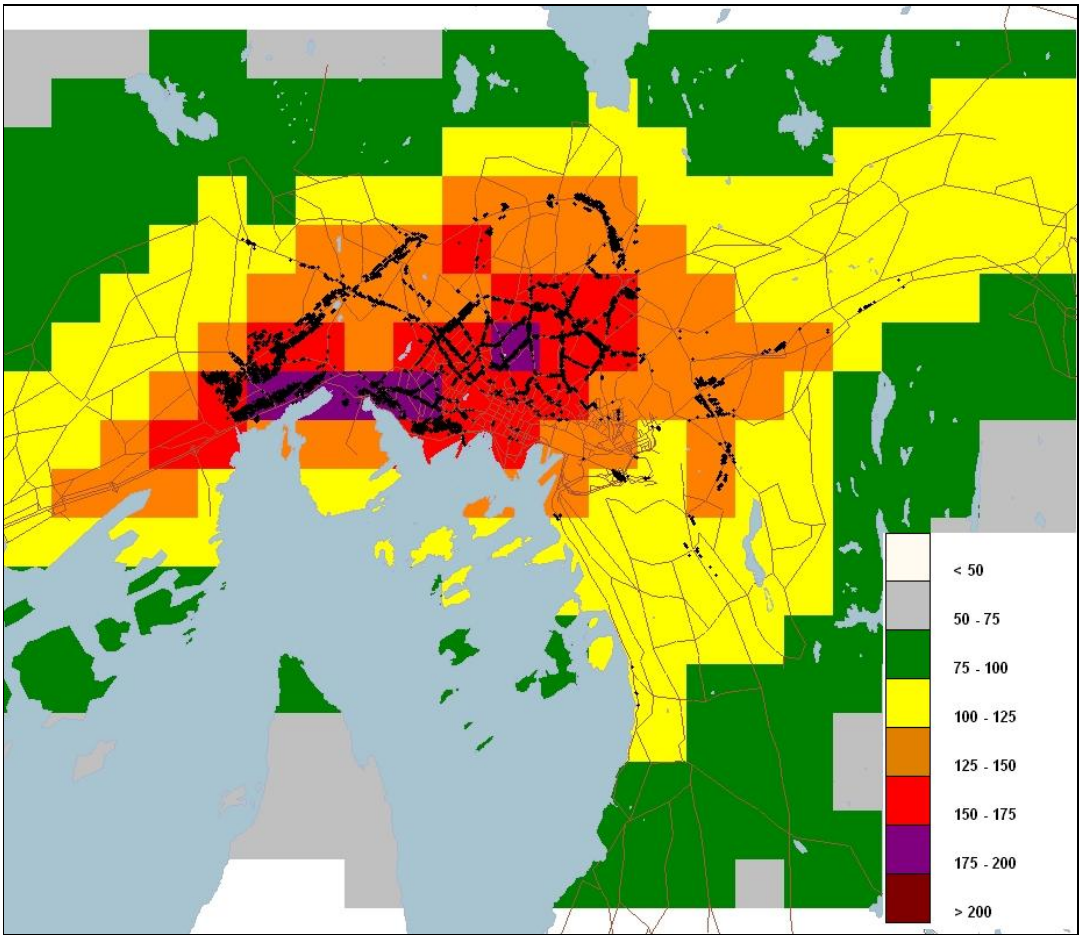

Figure 4: Projection of the 9^{th} highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2015. The black dots are illustrating the building points where the 9^{th} highest daily NO_2 value is above limit value of 150 $\mu g/m^3$.

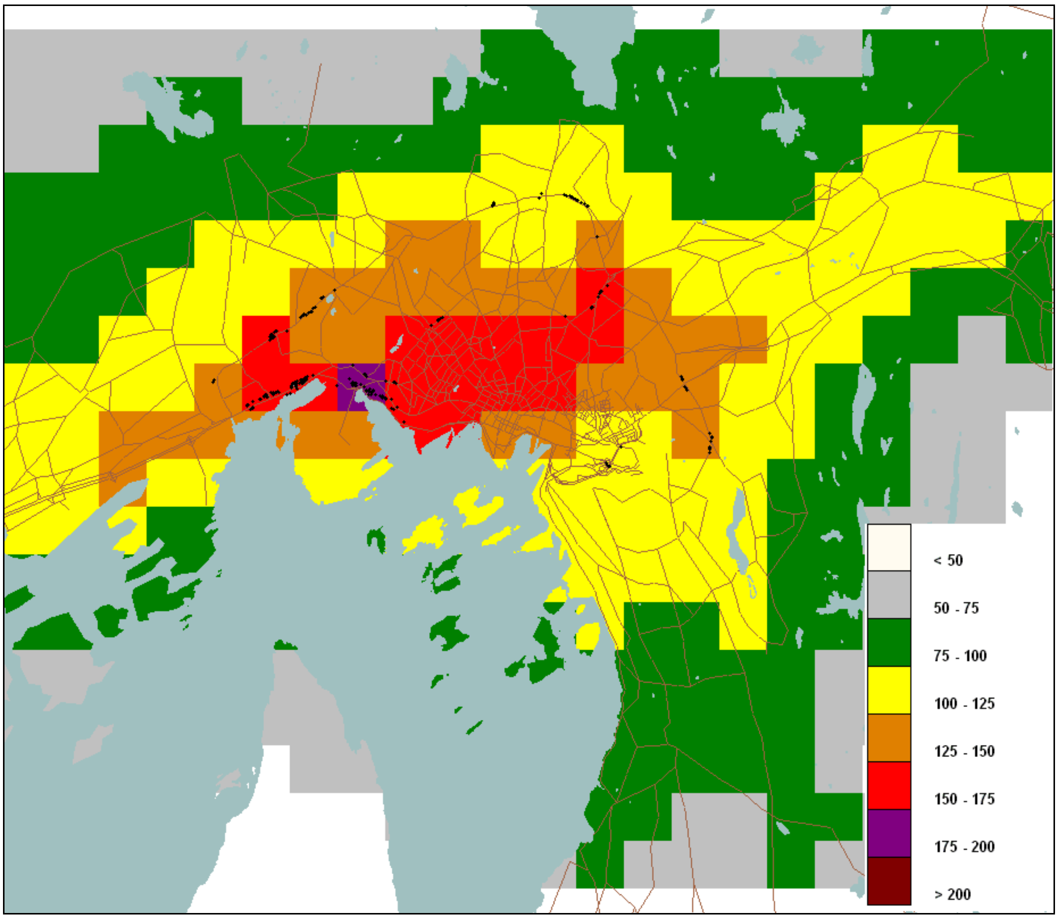

Figure 5: Projection of the 19th highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2015. The black dots are illustrating the building points where the 19th highest daily NO_2 value is above limit value of 200 $\mu g/m^3$.

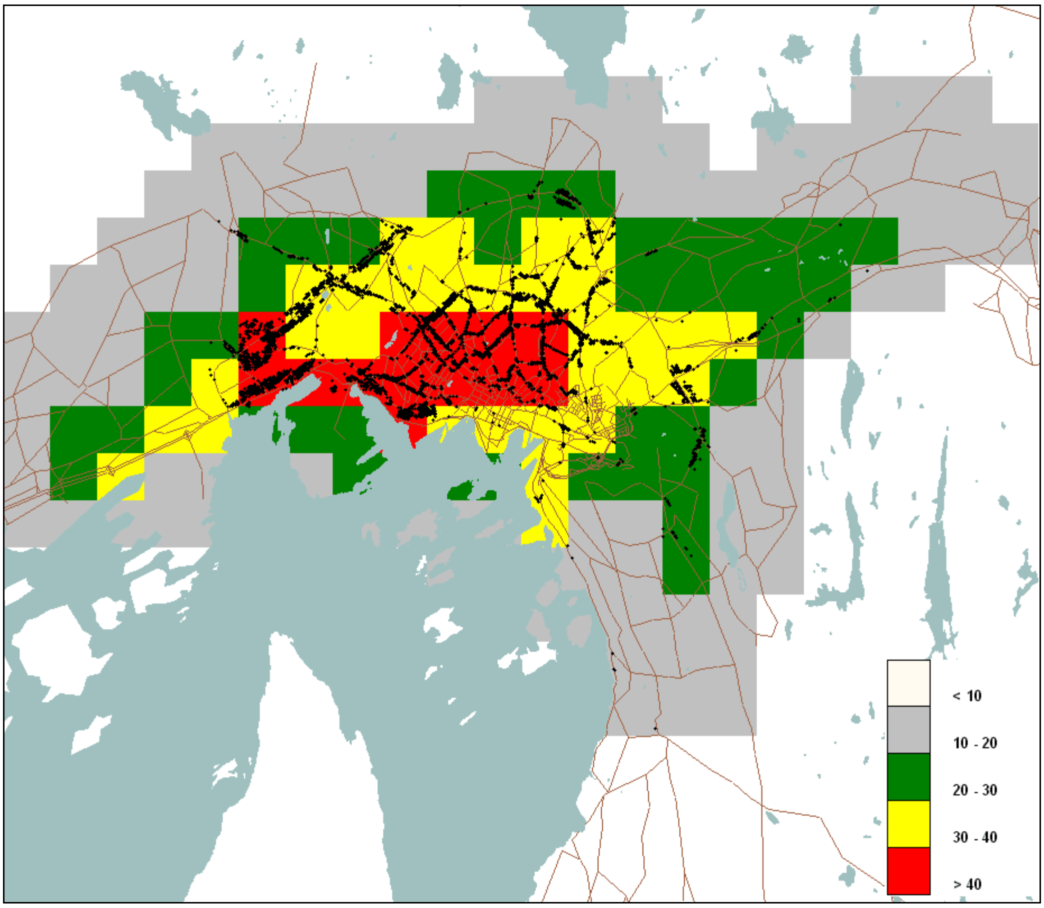

Figure 6: Projection of the yearly grid value (EU) of NO_2 ($\mu g/m^3$) for 2015. The black dots are illustrating the building points where the yearly value of NO_2 is above the limit value of 40 $\mu g/m^3$.

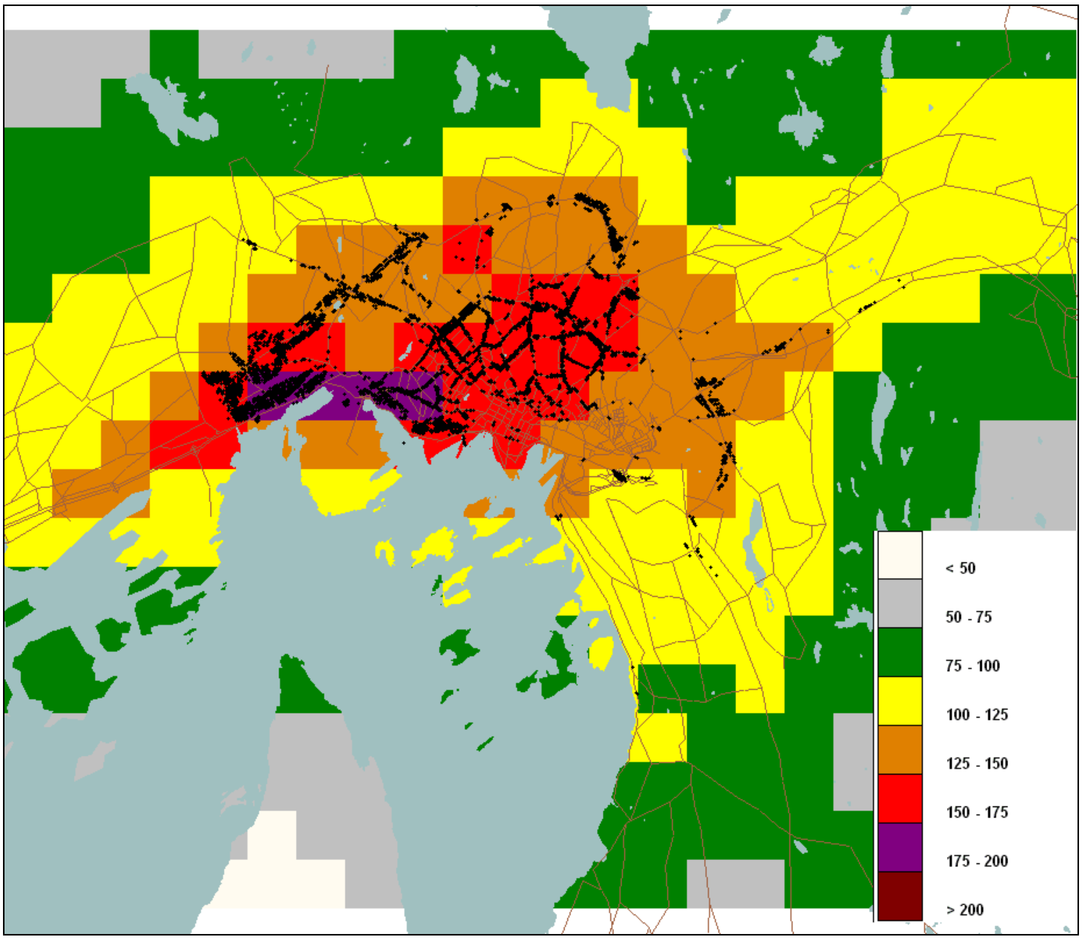

Figure 7: Projection of the 9th highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2020. The black dots are illustrating the building points where the 9th highest daily NO_2 value is above limit value of 150 $\mu g/m^3$.

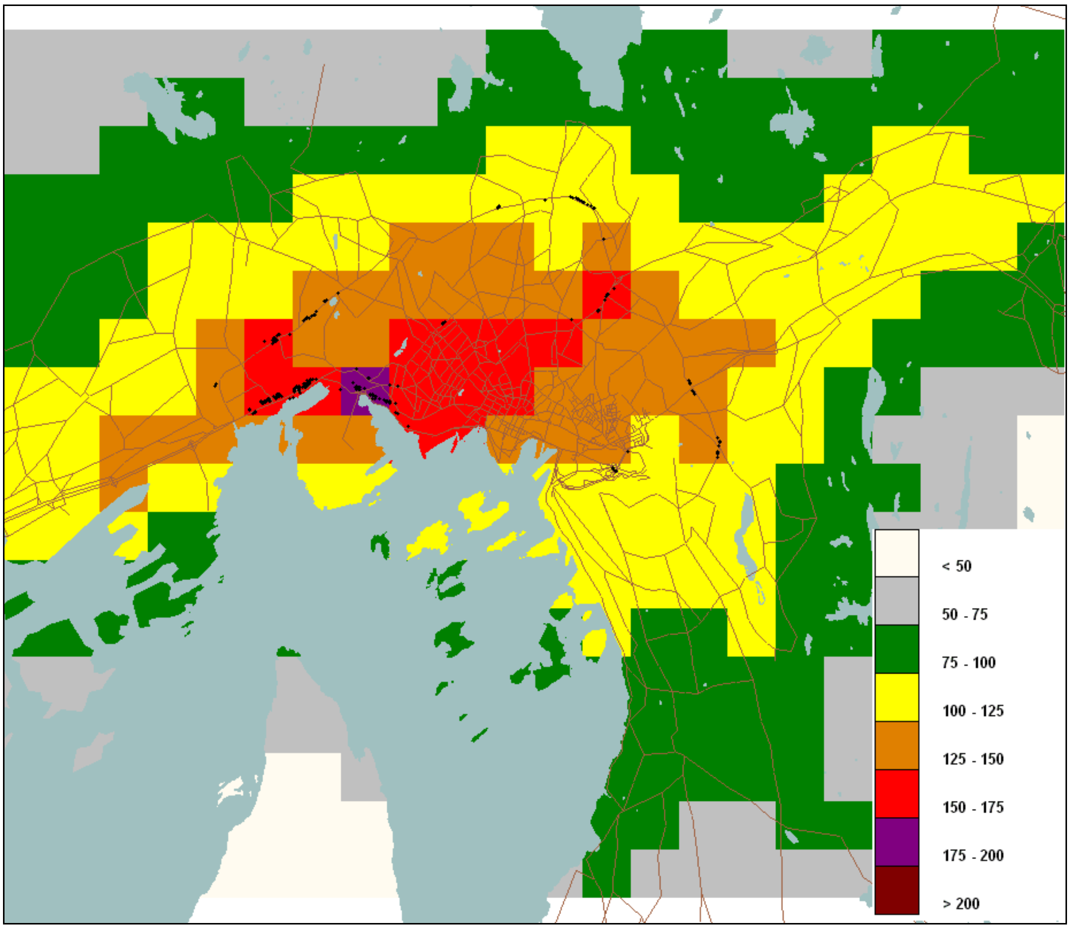

Figure 8: Projection of the 19th highest hourly grid value (National Target) of NO_2 ($\mu g/m^3$) for 2020. The black dots are illustrating the building points where the 19th highest daily NO_2 value is above limit value of 200 $\mu g/m^3$.

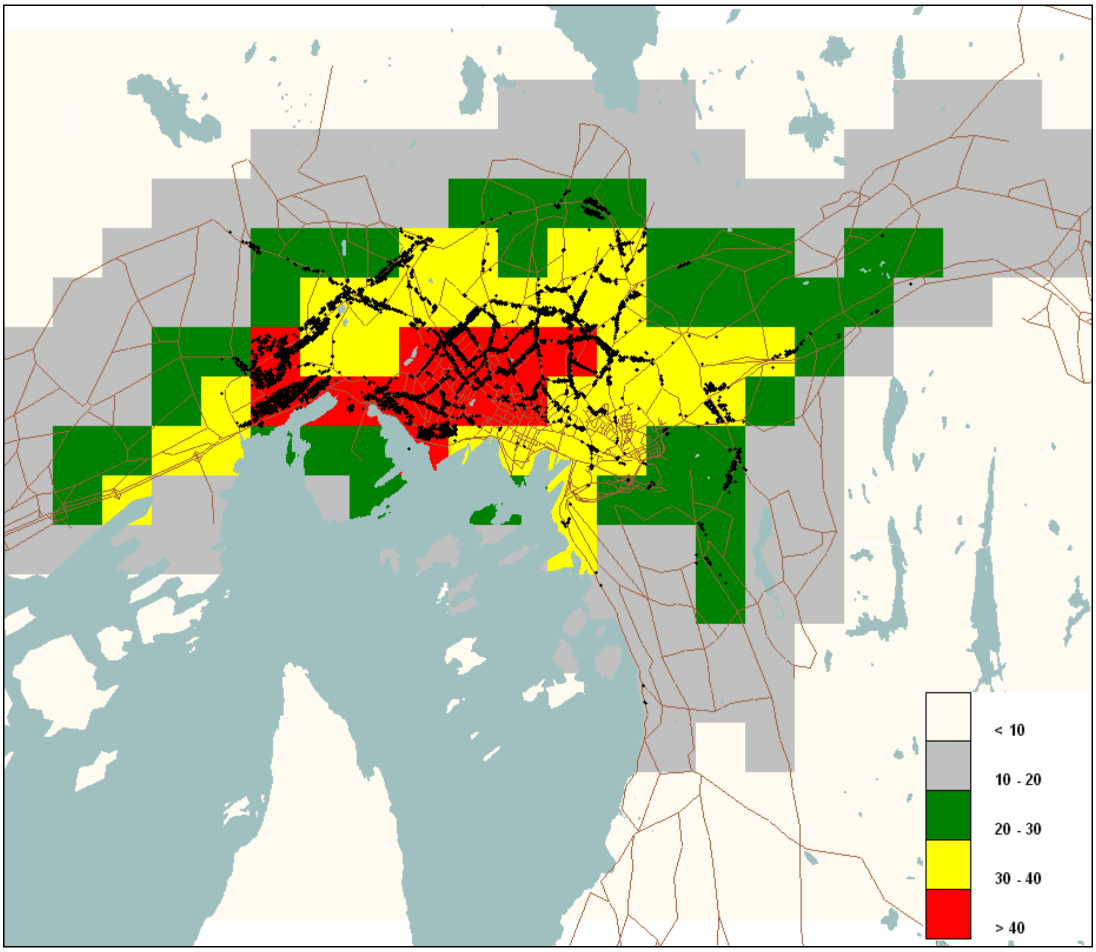

Figure 9: Projection of the yearly grid value (EU) of NO_2 ($\mu g/m^3$) for 2020. The black dots are illustrating the building points where the yearly value of NO_2 is above the limit value of 40 $\mu g/m^3$.

5 Discussion of the scenario results

Ever since the introduction of the 3-way catalyst, emissions of NO_X from vehicles have been steadily reduced. The emission limitations in the Euro class regulations have ensured that this trend continues. However, the emission limitations concern NO_X, and the observed development in NO_2 concentrations both in Norway and in Europe does not correspond to the emission reduction of NO_X. The main reason is believed to be an increase in primary NO_2 emissions from vehicles. The baseline and scenario calculations show that minor changes in the basis for calculating vehicular emissions can maintain the same NO_X-emissions while radically increase the NO_2-emissions. The scenario concentration and exposure calculations illustrate that for Oslo, the changes in NO_2 emissions have large impact on concentration levels near the limit values for air quality, and a different trend in NO_2-emissions lead to large changes in the population exposure. There are few data on the ratio of NO_2 / NO_X for vehicular emissions, and a rather large range of oxidation rates can be found for different vehicle types. In the scenario calculations, a radical change in the oxidation ratio for heavy duty vehicles has been assumed compared to previous estimates, and especially for the "next generations" (Euro 6).

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Appendix A

Description of the applied method for scaling the emissions from domestic wood burning in Oslo to 2010, 2015 and 2020

Scaling factors for emissions from domestic wood-burning

The basis for the database in the Oslo BASELINE project is the 2010 database from Oslo abatement study for 2010. We have only changes in consumption data from 2002 to 2020. From the description above we have following changes in consumption:

$\Delta F^{02-05} = 5.1$ and $\Delta F^{05-10} = 100 \cdot (1.01^5 - 1) = 5.1$.

The NO2 and NOx emissions for all the years, 2010, 2015, 2020 will be updated according to the changes in consumption from 2002 to 2010 e.g.:

$$\cdot \left(1 + \frac{\Delta F^{02-05}}{100}\right) \cdot \left(1 + \frac{\Delta F^{05-10}}{100}\right) \cdot Q^{02} = 1.105 \cdot Q^{02}$$

Table 8:Scaling of wood burning emissions for 2010, 2015, and 2020 for Oslo.

Database	NOX	NO2
OSLO_BASELINE_2010_BASIS	$1.105 \cdot Q^{02}$	$1.105 \cdot Q^{02}$
OSLO_BASELINE_2015_BASIS	$1.105 \cdot Q^{02}$	$1.105 \cdot Q^{02}$
OSLO_BASELINE_2020_BASIS	$1.105 \cdot Q^{02}$	$1.105 \cdot Q^{02}$

Appendix B

Technical description of model calculations

1. Software versions

Table 9: AirQUIS specifications

	AirQUIS	**EPISODE**	**MATHEW**
Software versions	496	02.11.2005	21.12.2004

2. Meteorological data applied in the model calculations

Table 10: Meteorological data used for model calculations

	Period	**Parameters**
Valle Hovin	1.1.2005-.5.2005 and 1.10-31.12 2005	FF; DD; RH; precipitation, Temperature, Delta T

3 Regional background data applied in the model calculations

Observations for 2005 of daily averaged values of NO_2 and hourly values of ozone measured at the closest regional background stations have been applied as boundary conditions on the open boundaries of the model domain. To estimate of the regional contribution for 2010, 2015, and 2020 the measured hourly/daily data have been scaled (in percentage) according to EMEP predictions to 2010. 2015 and 2020.

Table 11: Boundary conditions for the model calculations . The measured regional background data for 2005 are scaled according to changes computed in the EMEP.

	Ozon	NO2
Stations	Maximum hourly values either from Birkenes, Hurdal or Prestebakke.	Birkenes
Period	1.1.2005-.5.2005 and 1.10-31.12 2005	1.1.2005-.5.2005 and 1.10-31.12 2005
Time resoultion	Hourly	Daily
Start time and end time for daily values		07:00-07:00

Table 12: Scaling of hourly/daily regional background values applied in the model calculations for 2010, 2015 and 2020.

	O3 (μg/m^3**)**	**NO2 (**μg/m^3**)**
Measured data from 1.1.2005-.5.2005 and 1.10-31.12 2005	Average: 67 μg/m^3	Average: 1.7 μg/m^3
Scaling factors from 2005 to 2010 applied on measured data	Average: 68.5 μg/m^3 Different scaling are used on hourly values for the different months. Scaling relative to 2005	Average: 1.5 μg/m^3 The daily/hourly values are changed with -10,6% relative to 2005 data.

	Month O3 1 +7.0% 2 +3.1% 3 +0.9% 4 -0.8% 10 +4.1% 11 +1.7% 12 +3.8%	
Scaling factors from 2005 to 2015 applied on measured data	Average: 71.1 μg/m^3 Different scaling are used on hourly values for the different months. Scaling relative to 2005: Mnd O3 1 +13.9% 2 +6.2% 3 +1.7% 4 -1.5% 10 +8.3% 11 +3.4% 12 +7.7%	Average: 1.4 μg/m^3 The daily/hourly values are changed with -21.1% relative to 2005.
Scaling factors from 2005 to 2020 applied on measured data	Average: 72.0μg/m^3 Different scaling are used on hourly values for the different months. Scaling relative to 2005: Mnd O3 1 +20.9 2 +9.3 3 +2.6 4 -2.3 10 +12.4 11 +5.1 12 +11.5	Average: 1.18μg/m^3 The daily/hourly values are changed with -36.2% relative to 2005.

Average background values for the simulation period are applied when a background value is missing.

Note: Since the values in the NILUdb are given as NO2_N, the values are converted from N to NO2 by use of the following relation: NO_2=NO_2-N*(46/14).

Negative background values means that the concentration is below the detection limit. In these situations we apply a background value which is equal to the absolute value multiplied by 2.

Background values of NO are set equal to zero.

4. Population data

Table 13: Population data. For all the calculations population data for 2005 are used, but number of people calculated in building points are updated according to changes in buffer zones due to increase of annual daily traffic.

	Total number of people (2005)	People calculated in building points (within buffer zones)
2005 reference	526258	90885
2010	526258	95950
2015	526258	120687
2010	526258	134162

5. Emission from wood burning

Table 14: Emissions from wood burning

		State of the environment 2005 (tons/year)	Oslo baseline calculations 2010 (tons/year)	Oslo baseline calculations 2015 (tons/year)	Oslo baseline calculations 2020 (tons/year)
PM10	Bærum	256.8	202.5	169.1	135.5
PM10	Oslo	330.4	260.6	217.6	174.3
PM10	SUM	587.1	463.1	386.7	309.8
NO2	Bærum	1.1	1.2	1.2	1.2
NO2	Oslo	1.6	1.7	1.7	1.7
NO2	SUM	2.7	2.9	2.9	2.9

6. Traffic data

Traffic emission factors:
2010/2015 and 2020

The vehicle distribution and average driving distance for light duty vehicles are according to prognoses from Institute of Transport Economics (Vehicle Generation Model BIG2) (Johansen, K.W. (2003))

The vehicle distribution for heavy duty vehicles are according to ongoing work from Statistics Norway (Kjetil Flugsrud, personal communication).

EURO 5 light duty vehicles are included. Emission factors from EEA (EEA,2006)

The NO2 fraction of NOx for light duty vehicles using diesel are updated (Air Quality Expert Group (2006)). The emissions are doubled for EURO 4 and EURO 5 compared to previous emission factor set.

2015

In previous calculations for 2015 also the vehicle class “hybrid cars” were included. This class is not included in the emission factor set anymore.

2015/2020
EURO 6 light duty vehicles are included. Emission factors from EEA (EEA,2006)

EURO 6 heavy duty vehicles are included. Emission factors estimated based on expected emissions inventory regulations from EEA (EEA,2006)

7. Conversion factor between winter mean and annual average

Table 15: Conversion factors between average winter mean (1 October to 1 May) and annual average for 2005.

Measurement stations: Kirkeveien, Manglerud og Alnabru	**PM10**	**NO2**
	0.815	0.888

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ABSTRACT
Commissioned by SFT, NILU has performed dispersion and exposure calculations to estimate the NO_2 concentrations for 2010, 2015 and 2020. A change in vehicular class composition and NO_X emission oxidation rates have been made to investigate the effect, and to better reflect recent years trends in measurement data.

NORWEGIAN TITLE

Alternative framskrivningsberegninger for NO_2 til 2010, 2015, 2020 for Oslo.

KEYWORDS		
Base line calculations	NO_2	Oslo

ABSTRACT (in Norwegian)
På oppdrag fra SFT har NILU gjennomført sprednings- og eksponeringsberegninger til 2010, 2015 og 2020 for NO_2 for å estimere forventede konsentrasjonsnivåer og antall eksponerte ut fra dagens utslipp prognoser . Sammensetning av kjøretøyklasser og NO_2-andelen av NO_X i utslipp er endret for å simulere en utvikling i NO2 konsentrasjon som reflekterer trend i måleserier.

** Classification*	*A*	*Unclassified (can be ordered from NILU)*
	B	*Restricted distribution*
	C	*Classified (not to be distributed)*