Algemene Rekenkamer

Air Quality Policy in the Netherlands

Publication in Regularity Audit Reports 2016 and 2017

2017 – 2018

Contents

1 Publication in Regularity Audit Report 2016 – Policy results

This chapter considers the findings of our audit of the results of the Minister of Infrastructure and the Environment's air quality policy. Our audit of the National Air Quality Cooperation Programme (NSL) was carried out at the request of the House of Representatives.

1.1 Reasons for the air quality audit

On average, air pollution costs everyone in the Netherlands 13 months of life; exposure to particulates is responsible for nine months' loss of life and exposure to nitrogen dioxide (NO_2) shortens life expectancy by a further four months (Maas, 2015). People who live in urban areas or close to motorways have an even shorter life expectancy. In view of the health consequences, the European Union has set air quality standards (pollution limits). The various standards and recommended air quality limits are explained in appendix 1. The Dutch government launched the National Air Quality Cooperation Programme (NSL) in collaboration with local and provincial governments in 2009 in order to improve air quality. The NSL has two objectives: (a) to ensure overall compliance with the statutory limits on nitrogen dioxide and particulates, and (b) to facilitate spatial development projects such as road widening and the construction of new business parks and housing developments. The House of Representatives identified the NSL as an area of special interest in the 2016 accounts of the Minister of Infrastructure and the Environment (I&M), and asked us to pay particular attention to the programme that was funded with national funds available at national, provincial and local level. We accordingly audited the NSL last year. The audit asked three key questions: what does the air quality policy entail, how much does it cost and what has it achieved?

Duration of the NSL

The NSL formally came into effect in 2009 but preparations began several years before. At the end of 2007, an amendment of the Environmental Management Act concerning air quality standards paved the way for the NSL strategy. With retroactive effect, the first and second tranches of grants awarded to local governments were transferred to the NSL in 2006 and 2007 respectively, as were the air quality policy goals and the budget of the Multiyear Development Programmes for the main cities for 2005–2009.

We concluded from our audit that air quality in the Netherlands had improved further during the NSL and there were fewer breaches of air quality limits even though more infrastructure, for example, had been built. But we also concluded that:air quality did not yet comply with the standards throughout the country, which had been one of the NSL's objectives (see section 1.1.1);

- the ministry had little insight into the funds spent to implement the NSL. Funds were spent both by central government on national measures and by provincial and local governments on local measures (see section 1.1.2);
- the ministry had little insight into how effective the measures had been. It was therefore uncertain whether better improvements could have been made with the same amount of funding (see section 1.1.3).

1.1.1 Air quality not up to standard everywhere: many locations close to the limits

Air quality throughout the Netherlands should have complied with the EU standards by 2015. Although it has improved significantly in recent decades, as disclosed in the Regularity Audit Report 2016 of the Ministry of Infrastructure and the Environment, the EU limits were still not being achieved in some places in 2015. In 2009, the European Commission granted the Dutch government permission to defer compliance with the limits for two substances. The limits for particulates (PM_{10}) came into effect as from 2011 instead of 2005 and those for nitrogen dioxide (NO_2) came into effect as from 2015 instead of 2010. Limits for the finer fraction of particulates ($PM_{2.5}$) have been in force throughout the EU since 2015.

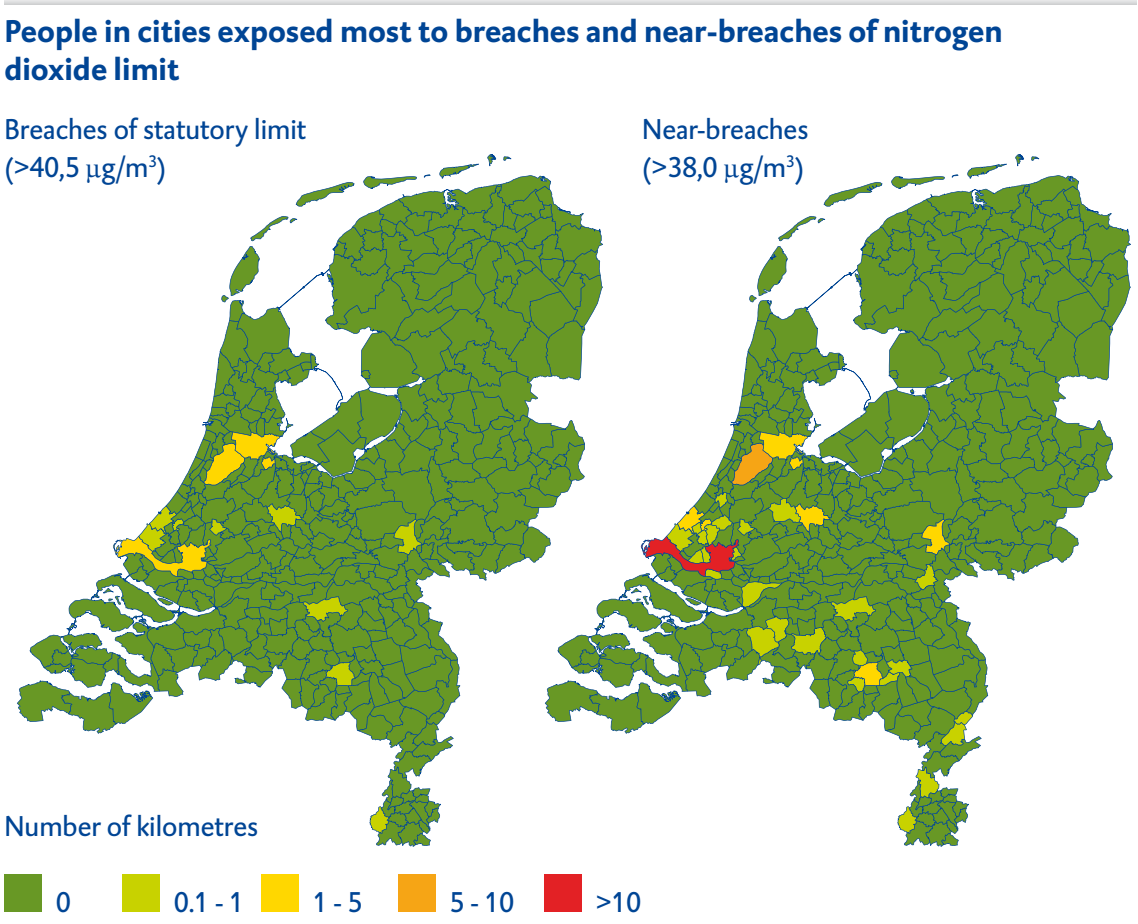

Figure 1 *Breaches of the statutory nitrogen dioxide limit (>40.5 µg/m^3) in 2015 (left) and breaches of a lower limit (>38 µg/m^3) in 2015 (right), measured by number of road kilometres per municipality. Source: Van Zanten et al., 2016*

Air quality: nitrogen dioxide

Figure 1 shows that the nitrogen dioxide limit is breached chiefly along roads in highly populated municipalities. Air quality has a greater impact on public health in those municipalities. The map on the right shows that near-breaches occur in about 20 municipalities. The number of road kilometres where nitrogen dioxide concentrations are close to the limit is higher in those municipalities. The number of breaches is influenced by uncertainties in the calculations, and fractional increases in concentrations can have a significant impact on the number of breaches. An analysis of nitrogen dioxide by the National Institute for Public Health and the Environment (RIVM) found that the number of breaches could be ten times higher if the calculations were based on different variables: e.g. 100 km of road instead of 10 km (Van Zanten et al., 2016).

Air quality: particulates

The main sources of particulates are road traffic and intensive livestock farming, particularly poultry farming. The particulates limit (PM_{10}) is breached mainly in areas with a high density of such farms, such as Gelderland, Limburg and North Brabant. No breaches of the annual limit for $PM_{2.5}$ were observed. Even if the EU limits are not breached, however, public health can still be harmed. The State Secretary for Infrastructure and the Environment has indicated that policy will in future be geared more to maximising the health gains than to tackling local problem areas (I&M, 2016b). At the request of the minister, the Health Council is accordingly drafting an advisory report on how such a policy can be implemented.

Spatial projects

As well as improving air quality, the NSL was introduced in order to facilitate spatial development. The amendment of the Environmental Management Act in 2007 enabled spatial development decisions to be checked as part of an overall development programme (for larger projects) and exempted individual projects that had little if any impact on air quality. This amendment prevents projects subject to the NSL being cancelled on account of their impact on air quality.

1.1.2 Little insight into use of funds

The 2009 NSL programme provided a budget for the expected expenditure on each type of measure (VROM, 2009). The Ministry of I&M does not keep annual accounts of expenditure on the various NSL measures. We used information from I&M to reconstruct the expenditure in 2005-2016. The Ministry of I&M informed us that the picture was provisional. It intends to present a definitive picture when the final assessment planned for 2019 is completed. With the exception of measures relating to the main road network, we could not determine whether or not the funds were actually spent on NSL measures.

Table 1 *Budgeted and cumulative expenditure by type of NSL measure, 2005-2016 (in millions of euros)*

Type of measure	Budget 2005–2015	Cumulative expenditure to year–end 2016
National measures (central government)	524	380*
Local measures (local governments)	372	388**
Main road network measures (Rijkswaterstaat)	625	12
Research and innovation	30	18***
Total	**1.551**	**797**

* Including several measures not included in the NSL. The amount is based on information from the Ministry of I&M.

** The amount consists largely of advance payments still awaiting final settlement, including €16 million from the Air Quality Action Plan for expenditure in Rotterdam and Amsterdam (I&M, 2015) provided via the Municipalities Fund.

*** Excluding expenditure on research into air scrubbers included in the NSL.

The table above shows that expenditure was lower than initially budgeted in 2009. This was largely because the amount budgeted for the main road network was based on a worst case scenario drawn up in 2008. The background concentrations and emission factors in that scenario, however, proved overly pessimistic in 2009. It was decided to reserve the amount considered necessary in 2008 in full to cover any setbacks (VROM, 2009). As air quality improved faster than expected, the reserve was not needed.

Local measures implemented by provincial and local governments

Under the NSL, a special purpose grant totalling € 320 million was awarded in four tranches to the provincial governments in order to implement local measures (I&M, 2016a). The provinces themselves spent only a small fraction of these funds on NSL measures. They passed on most of the grant (about 95%) to local governments in the form of advance payments. It was agreed that the provinces and municipalities would account for the funds by means of the Single Information, Single Audit (SISA) system and a final settlement would take place at the end of the NSL. As the central government had awarded all the funds for local measures to the provinces, it would also settle the payments with the provinces, and the provinces would in turn settle the funding with the municipalities.

The duration of the NSL has been extended several times and the final settlement has accordingly been put back. The special purpose NSL grant will now end on 1 January 2017 (I&M, 2016c) and final settlement, covering a period of more than ten years, will take place after this date. We think there is a risk in postponing the settlement for so long. We

pointed out in our 2006 report entitled Policy Freedom and Special Purpose Grants that multiyear accountability was contrary to the Government Accounts Act 2001 and its annual cycle of budget preparation, implementation and accountability. Under the Act, parliament must be informed of policy expenditure and policy results and of the regularity of obligations, expenditures and receipts every year (Netherlands Court of Audit, 2006).

Complex accounting system for advance NSL payments

To settle the advance NSL payments in accordance with the regulations, there must be an insight into the cumulative expenditure of the government grants awarded to the local governments. The SISA appendices of the eight participating provinces contain information on the cumulative expenditure incurred by the local governments. The provincial auditors check the cumulative expenditure as to its soundness, not as to its regularity.

The SISA appendices prepared by the municipalities account for expenditure in a particular year. The municipal auditor checks the regularity of the expenditure. The cumulative expenditure in the SISA appendix of the municipal accounts is not audited.

Although the SISA accounting system in principle produces reliable information, errors in the cumulative expenditure disclosed in the provincial accounts cannot be ruled out as its regularity is not audited directly. This is a matter of some concern in view of the final settlement of the NSL.

To ensure that the settlement of advance NSL payments is regular, it is also necessary to have an insight into the cofinancing of NSL measures by local governments. Cofinancing is a condition for the third and fourth tranches. Local governments were required to contribute at least € 233 million to fund the NSL measures (I&M, 2016a). It is unclear whether they actually did so.

1.1.3 Limited insight into the cost effectiveness of measures; little scope to learn or improve

It is not known whether the mix of national and local measures was the most appropriate way to improve air quality. A better improvement might have been achieved with the same money, or an equivalent improvement with less money. The financial accounts are not linked to the programme's substantive results. The links between national and local measures and how they reinforce each other are also uncertain. We found that the Ministry of I&M had failed to learn from or steer the programme during its implementation.

The final evaluation of the NSL has been postponed several times and is now planned for 2019, ten years after the programme was formally launched in 2009. There have been no interim evaluations. On account of the long duration of the NSL programme, a midterm evaluation could have been of added value, if only because the Netherlands had already recorded breaches and near-breaches of the limits in 2015. Furthermore, lower particulate and NO_2 concentrations can contribute to an improvement in public health; improvements below the EU air quality limits are therefore also important. The formal rules of the Periodic Evaluation Regulations, moreover, require ministers to evaluate a programme periodically (between four and seven years after its introduction).

The Minister of I&M announced in the 2016 regularity audit report that the evaluation of the NSL would commence in 2018, with completion planned for 2019. The minister will present the audit design for the evaluation to the House of Representatives before Budget Day 2017. To date, therefore the ministry has had only a limited insight into the cost effectiveness of the four different types of NSL measures: national (generic) measures, local measures, measures relating to the main road network, and measures to promote research and innovation. We therefore carried out an additional study to determine whether information was available on the impact of each type of measure. Below, we explain whether or not such information is available for each type of measure. Appendix 1 presents more detailed information on the evaluations available for individual measures.

Effectiveness of national measures

We asked whether individual evaluations were available of national measures and what was known about the measures' effectiveness. Evaluations are available for more than a third of the 30 or so national NSL measures. Most of them are publicly available. The evaluations related mainly to the incentive schemes for cleaner vehicles, such as grants for particulate filters and the national scrappage scheme. Few if any evaluations had been available of measures in other sectors (agriculture, industry and energy, shipping). We found just one evaluation of the tax measures taken by the Ministry of Finance in the period 2008–2013 (such as the motor vehicle or road tax discount). The evaluation, however, was concerned with the impact on CO_2 emissions and not on the impact on air quality.

Effectiveness of local measures

As well as national measures, the NSL includes local measures, measures relating to the main road network and measures to promote research and innovation. The Ministry of I&M has little insight into the effectiveness of local measures funded from the NSL,

although it was funded by the minister. We found that information was available chiefly on the functioning of local environmental zones. Clean buses and environmental zones have a positive and readily quantifiable impact on air quality in urban areas.

Effectiveness of measures relating to the main road network

Little information is available on the effectiveness of the measures relating to the main road network. Only one type of measure has been implemented under the NSL: the erection of noise barriers. Measures taken outside the NSL include the introduction of 80 and 130 km/h zones, which also have an impact on air quality. Some information on the effectiveness of these measures is available.

Effectiveness of research and innovation measures

Two research programmes have been carried out under the NSL. Both generated new knowledge on the effectiveness of the innovative measures studied. Innovative ways to clean road surfaces or to plant vegetation alongside roads were found to be less effective than noise barriers.

Cost effectiveness

As noted in the previous section, the minister generally does not request financial progress information on the cost of the measures carried out. It is accordingly difficult to express an opinion on the measures' cost effectiveness. One exception to this is the incentive scheme introduced by the Ministry of I&M itself, as the expenditure is recorded in the ministry's own accounts. Information is therefore available on only the cost effectiveness of national measures. The table below summarises the overall insight into cost effectiveness of the four types of NSL measures.

Table 2 *Insight into the cost effectiveness of the four types of NSL measures*

Type of measure	Insight into effectiveness	Insight into cost
National measures	Partial (a third)	Very limited
Local measures	Partial (e.g. environmental zones)	No
Measures relating to the main road network	None or very limited	No
Research and innovation	Yes	N.A.
Overall insight	Partial, but limited	None or very limited

Appendix 1 presents a provisional picture of the effectiveness of the four types of measures based on the available evaluations. We intend to issue a separate publication on air quality later this year (fourth quarter of 2017) as part of the joint audit of air quality being carried out by 16 (mainly European) Supreme Audit Institutions. An overarching report on this joint audit is planned for 2018.

1.2 Recommendations

1. During the final evaluation of the NSL, consider the experiences of local governments and the relationship between the measures taken by local governments and those taken by central government. Also consider the tax measures and measures taken by industry and agriculture. The evaluations already carried out seem to focus on the incentive schemes for cleaner vehicles.
2. Link the funding to the results achieved. Opinions can then be given on the cost effectiveness of the measures.
3. With a view to the forthcoming final settlement of the advance NSL payments, make sure that reliable information is available on the money spent by local governments to improve air quality.

1.3 Response of the Minister of Infrastructure and the Environment

The National Air Quality Cooperation Programme (NSL) states what action the government is planning at various levels to take in order to improve the quality of the air in the Netherlands and to allow infrastructural projects to go ahead. The picture now emerging (based in part on a system of annual monitoring) is that there has been a significant improvement in air quality, that air pollution no longer forms an impediment to spatial development projects, and that these results were produced at a lower cost than originally projected. As far as the remaining issues are concerned, the government bodies involved have agreed on how these should be tackled. The Court's input is particularly welcome given the fact that the government is planning to review the NSL in the future.

In the meantime, the State Secretary has announced, in part on my behalf, that we will be acting on a motion put before parliament to work together with the local and regional authorities and representatives of trade and industry, to draw up a new national air-quality plan aimed primarily at achieving health gains rather than solving local issues. Together with the parties involved, we will be seeking to assess what sort of measures are likely to be effective, in terms of both health gains and cost.

Before the Environmental Management Act was amended in 2007, many construction projects in the Netherlands were blocked after specific plans were scrutinised in terms of their impact on the limit values for particulates and nitrogen dioxide. The decision to amend the Environmental Management Act came at the same time as funds were made available from the Economic Structure Enhancing Fund for improving air quality. It is in this context that the effectiveness and efficiency of expenditure should be viewed. The government assumed that, after the Act had been amended, it would no longer be common practice to assess the impact of specific projects on the limit values, and that air-quality standards would be upheld by the combined effects of a package of measures for improving air quality and undertaking spatial development projects. These measures were brought together in the shape of the National Air Quality Cooperation Programme (NSL).

The fact that the NSL is an inter-administrative programme (i.e. involving a number of strata of government) will be a key element in the review process. This is because we expect regional and local democracy to be a vital aspect of the NSL, in terms of both management and control on the one hand and accountability on the other. The Ministry will seek to strengthen the effectiveness of regional and local schemes by insisting that the authorities in question match all payments made from the 3rd and 4th tranches.

The local authorities report to the provincial councils in the form of a Single Information Single Audit (SISA). Given that the NSL has already been twice extended, certain financial reports from the local authorities are now available. Once the local authorities' auditors have confirmed the regularity of the expenditure in question, the provincial council reports to the central government, also in the form of a Single Information Single Audit (SISA). The provincial council's auditor certifies that council expenditure has been lawful (or 'regular') and that the financial statements for the local authorities have been properly prepared. Finally, the Government Audit Service undertakes a single review of the reports issued by the provincial council's auditors. The information in the SISA is one of the elements used in fixing the level of the provincial council's contribution.

I would like to conclude by wishing you good luck with your international follow-up audit of air quality. I hope to be able to make use of the findings when the time comes to conduct the policy review.

1.4 Afterword Court of Audit

In her response, the Minister states that the State Secretary for Infrastructure and the Environment, acting in part on the Minister's behalf, is planning to work together with local and regional authorities and representatives of trade and industry to draw up a new national air-quality plan that is designed more with public health in mind than with local air-quality issues. We would stress the importance, in relation to any new plan, of linking expenditure as far as possible with policy results. We urge the State Secretary to make clear arrangements in advance as to how the necessary information should be obtained, especially as the plan involves a combination of measures for which different parties are responsible.

As a further point, the Minister refers in her response to the fact that the NSL is an inter-administrative programme, and also to the fact that the regional and local authorities have their own reporting mechanisms. We believe that this situation actually creates good opportunities for learning from the experiences gained at other levels of government and in other areas of policy. Hence our recommendation to pay specific attention, in the forthcoming policy review, to the mutual effects of measures taken by regional and local authorities and those taken by central government, and not to limit the scope of the final review to measures affecting the transport sector. Unfortunately, the Minister does not address this point in her response.

2 Publication in Regularity Audit Report 2017 – Policy results

2.1 Follow-up to the audit of central government 2016

The 2016 audit of central government found that the Minister of Infrastructure and the Environment (I&M) had only a limited insight into the cost effectiveness of the measures implemented as part of the National Air Quality Cooperation Programme (NSL). She did not know whether the mix of national and local measures was the best approach to improve air quality in the Netherlands and we were unable to form an opinion on the cost effectiveness of the measures. In other words, it could not be said whether the minister could have achieved more with the same amount of money or achieved the same outcomes with less money.

Table 3 *Insight into cost effectiveness of the four types of NSL measures (taken from the 2016 audit of I&M)*

Type of measure	Type of measure	Type of measure
National measures	Partial (a third)	Very limited
Local measures	Partial (e.g. environmental zones)	No
Measures relating to the main road network	None or very limited	No
Research and innovation	Yes	N.A.
Overall insight	Partial, but limited	None or very limited

The 2016 audit of central government also found that the Minister of I&M had failed to learn lessons from the programme and had not made any changes to it during its implementation. She had not carried out an interim evaluation and the final evaluation of the NSL had been postponed several times. It is now planned for 2019, ten years after the programme's formal launch in 2009.

This year, we want to provide more insight into the cost effectiveness of the Netherlands' air quality policy. To do so, we commissioned the National Institute for Public Health and the Environment (the RIVM) and the environmental consultancy CE Delft to carry out a follow-up study to calculate the impact that eight selected NSL measures had had on reducing emissions of fine particulates ($PM_{2.5}$) and nitrogen dioxide (NO_2). We also asked

the two organisations to calculate the overall health gain brought about by the eight measures.

It follows from the calculations that, taken as a whole, the eight measures reduced road traffic emissions by 2% per annum in the period 2006-2015 but had had only a limited impact on reducing the overall disease burden. Individually, the measures had had very divergent impacts. We therefore concluded from our audit that in all probability the minister could have achieved more with the same amount of money. She could certainly have achieved the same reduction in emissions at lower cost if she had known about the impact of the individual measures. We draw this conclusion from the following findings regarding the eight selected NSL measures:

- the eight measures together had had a positive impact on emissions but the impact of some of them had been negligible (section 2.1.2);
- five of the eight measure had been cost effective. The social cost of the other three measures was higher than the shadow price (section 2.1.3);
- the eight measures had had only a limited impact on public health as a whole. The overall disease burden fell by just 0.02 – 0.01% (section 2.1.4).

Our audit was part of a joint audit of air quality that is being carried out in cooperation with 16 (mainly European) Supreme Audit Institutions. The results of this joint air quality audit will be published in a joint report at the end of 2018.

2.1.1 The follow-up audit: methodology

We first selected eight national measures in the NSL that were designed to reduce emissions from road traffic. The road traffic sector is the largest source of emissions in the Netherlands and the particulates in exhaust fumes are amongst the most harmful to human health. This is why we selected eight measures in the road traffic sector.

Selection of eight national NSL measures, with duration and grant amounts

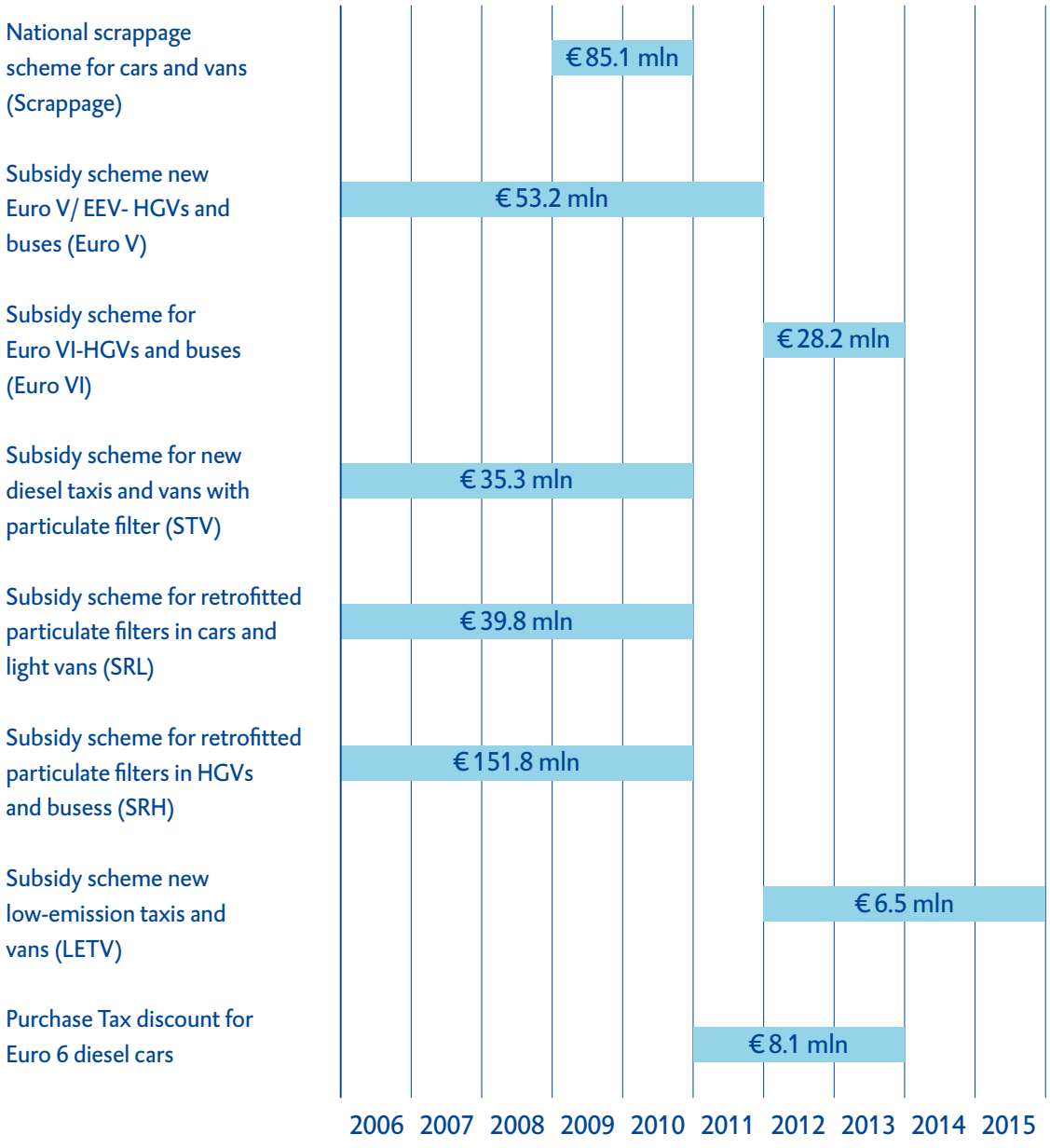

Figure 2 *The eight measures audited, duration and total grant*

We wanted to know how much the measures had contributed to reducing emissions of fine particulates ($PM_{2.5}$) and nitrogen dioxide (NO_2) in the Netherlands. One of the NSL's aims was to ensure timely compliance with the EU limits on emissions of particulates (PM_{10}) and nitrogen dioxide (NO_2). CE Delft calculated how much the eight measures had

reduced these emissions. It also calculated the financial/monetary cost per unit of emission reduction (in euros per kilogram of $PM_{2.5}$ and in euros per kilogram of NO_2).

An important reason for carrying out the joint air quality audit is that air pollution is the largest contributor to the environment-related disease burden. A study by the RIVM found that air pollution in the Netherlands cut average life expectancy by about nine months for every person in the country (Maas R et al., 2015). We were therefore also interested in the health impact of the eight measures (the non-monetary/non-financial benefits). On the basis of CE Delft's emission calculations, the RIVM estimated the reduction in concentrations of NO_x and $PM_{2.5}$. It then calculated the total health gain brought about by the total package of measures. This audit covers the period between 2007 and 2015. The methodology used for both studies is presented on our website at www.rekenkamer.nl/verantwoordings-onderzoek.

2.1.2 The follow-up audit: results

Effectiveness in terms of emission reduction

CE Delft calculated the emission reduction brought about by each of the road traffic measures. It concluded from its study that, taken together, the eight measures had reduced road traffic NO_x and $PM_{2.5}$ emissions by 2% per annum in the period 2006–2015 (CE Delft, 2017a). The figures below show the results of its calculations for each measure.

The eight measures have reduced emissions but some have had a negligible impact. Some of the eight measures had an impact on the emission of nitrogen dioxides (NO_x), some on the emission of fine particulates ($PM_{2.5}$) and some on the emission of both pollutants.

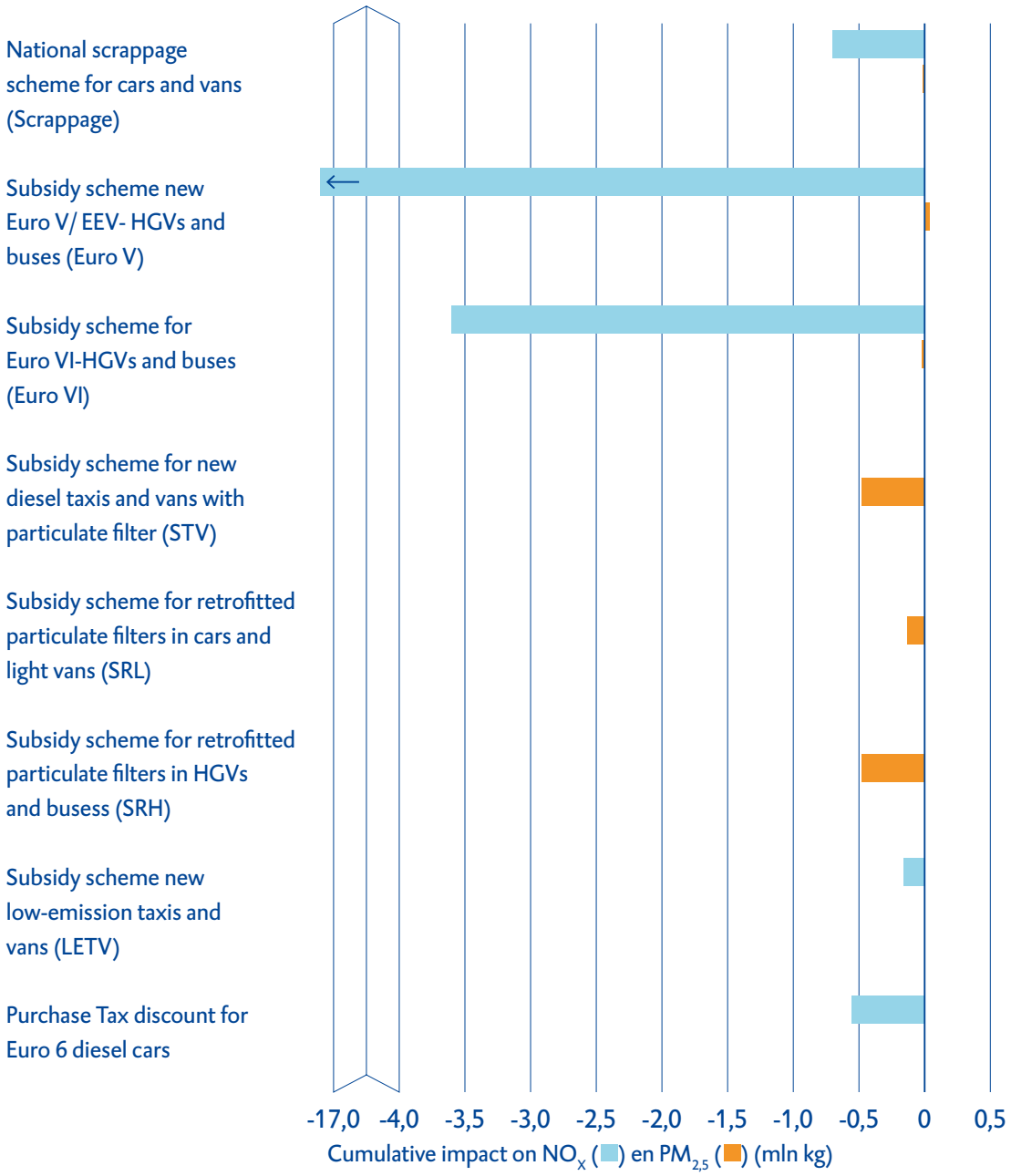

Figure 3 *Impact of the eight measures, reduction in* NO_x *and* $PM_{2.5}$ *emissions*

The cumulative impact is the emission reduction in the years from the date a vehicle is purchased (or modified) on account of the measures up to the date it is removed from the road (by being exported or scrapped). This period is longer than the term of the measures because vehicles can continue to be driven and have an emission reduction impact long after the measures have ended.

Figure 3 shows that all eight measures reduced emissions to one degree or another. Some reduced nitrogen dioxide emissions, some reduced particulate emissions and some reduced both. The Incentive scheme for new Euro V / EEV HGVs and buses (Euro V) had the most pronounced impact on nitrogen dioxide emissions. The scheme for new taxis and vans with diesel particulate filters (STB) and the scheme to retrofit diesel particulate filters in HGVs and buss (SRV) had a relatively large impact on particulate emissions. The other five measures had a far smaller cumulative impact on NO_x and/or $PM_{2.5}$ emissions. Although the calculations were concerned only with the reductions in the Netherlands, the measures can also have an impact outside the Netherlands.

Cost effectiveness in euros per kilogram emission

CE Delft subsequently calculated the cost effectiveness (in €/kg $PM_{2.5}$ and €/kg NO_x) of the eight measures.

Figure 4 shows the social cost effectiveness of the road traffic measures. For clarity's sake, it shows the social costs (e.g. investment costs, maintenance costs and fuel costs) relative to the benefits in the form of emission reductions. To determine whether a measure was a cost effective investment or not, a limit was set, above which the investment is no longer efficient. The shadow price for $PM_{2.5}$ was calculated using the Environmental Cost method at € 183 per kg $PM_{2.5}$ equivalent; all measures costing less than this shadow price were cost effective (CE Delft, 2017b).

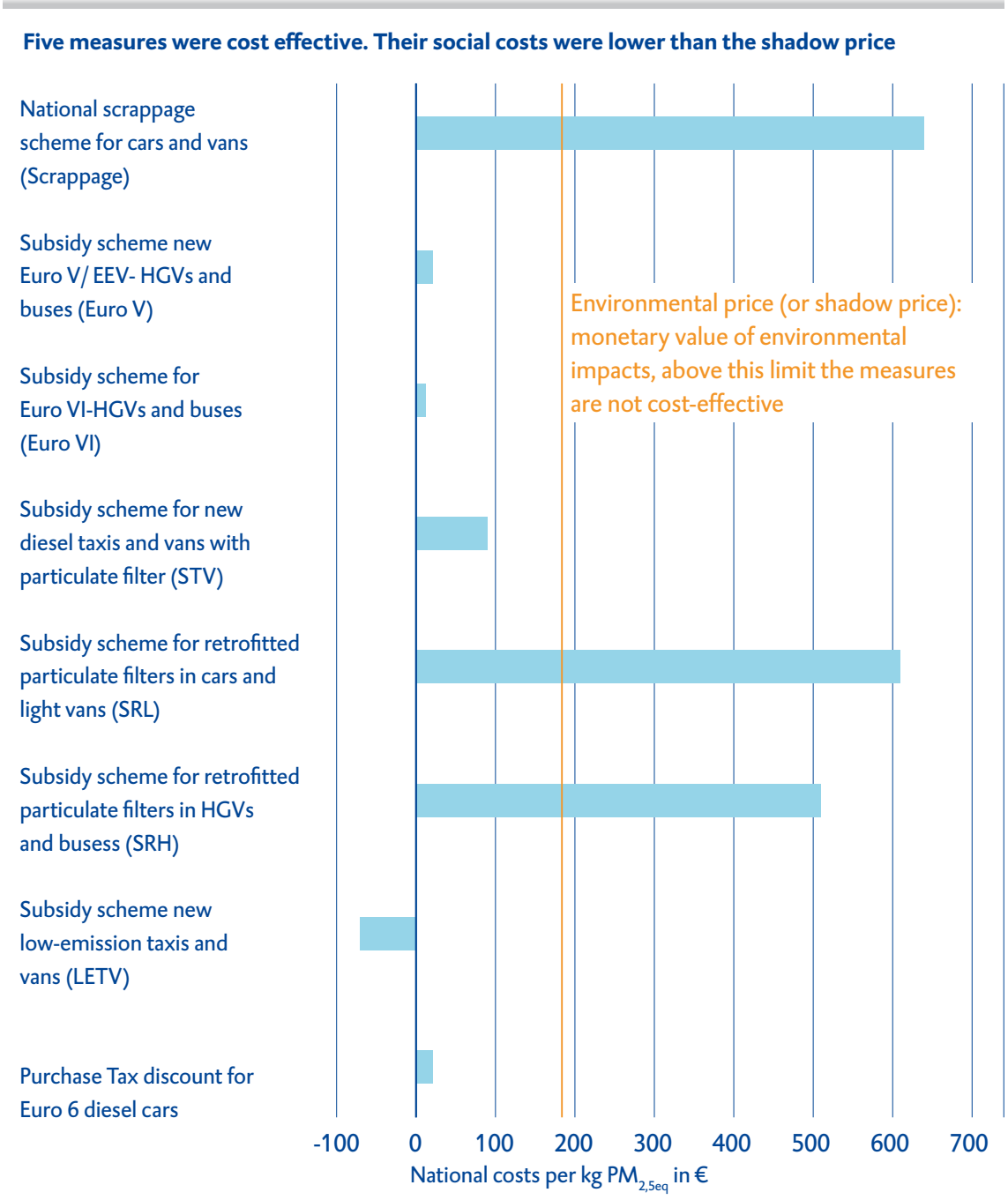

Figure 4 *Cost effectiveness of the eight measures*

It can be concluded from the shadow price that the most cost effective scheme was the one for new low-emission taxis and vans. It reduced the social cost of emissions more than the measure itself cost. The Euro V and Euro VI schemes for HGVs and buses, the vehicle purchase tax discount for Euro 6 cars and, to a lesser degree, the scheme for new taxis and

vans with diesel particulate filters produced the lowest social costs. The other three measures were relatively expensive. CE Delft noted that some of the measures (scrappage premium, retrofitting of diesel particulate filters in cars and vans, and, to a lesser degree, retrofitting of diesel particulate filters in HGVs and buses) had an impact chiefly on urban road traffic. Although this was not studied further, these measures could make a bigger contribution to solving local air quality problems in urban areas. Figure 5, however, is concerned with the national impact.

Health benefits in terms of the overall disease burden and years of life gained

The NSL was initially introduced not only to improve air quality but also, and mainly, to facilitate spatial development, such as the construction of new roads and business parks. At the time, health gains were not at the top of the list of desired impacts. We audited the health benefits of the eight NSL measures because particulate atmospheric pollution is the largest contributor to the environment-related disease burden and the minister wanted to focus the new national air quality plan more on health gains.

We concluded from the RIVM's calculations that the eight measures had together reduced NO_x and $PM_{2.5}$ concentrations and the overall disease burden by between 0.02% and 0.01%. The overall disease burden is the outcome of all the determinants that contribute to ill health and premature death (such as lifestyle, working conditions and environmental quality). Environmental pollution is responsible for 6% of the overall disease burden in the Netherlands. Air pollution is in turn responsible for more than 80% of the disease burden caused by environmental factors (therefore for about 5% of the overall disease burden).

An average reduction in the overall disease burden of 0.01% is equal to 1,150 years of life gained for the entire population of the Netherlands. The RIVM estimates the value of a 0.01% reduction in the overall disease burden at at least € 94 million. The RIVM based its calculation on indicators set by the World Health Organization (WHO). One of the indicators is asthmatic complaints among children (5–18 years). By way of illustration, the RIVM's study showed that asthmatic children (between 5 and 18 years old) enjoyed a health gain of 433 days per annum. This means that the eight measures led to the entire group, not each individual child, enjoying 433 days without asthmatic complaints each year.

As noted above, the RIVM estimated the changes in NO_x and $PM_{2.5}$ concentrations and the health gains on the basis of CE Delft's emission calculations. Our audit found that the RIVM and CE Delft used two different methods to calculate the health gains. The two methods

produced different results owing to the inclusion or omission of the health impact of nitrogen dioxides (NO_x). The RIVM did not include the direct impact of NO_x in its calculations because the extent to which it overlaps with the impact of particulates is not known. This method is consistent with current WHO guidelines. Our audit uses the RIVM's results for health impacts because the WHO guidelines will also be used in the joint air quality audit.

2.2 Recommendations

As laid down in policy articles 20 and 24 of the 2018 budget, the Minister of I&M has a duty to manage, promote and oversee improvements in air quality. To manage and adapt the policy, she needs information on how the measures work.

The Minister of I&M is currently working on a new national air quality plan. In her response to the previous year's audit of central government she said the new national air quality plan would be focused more on health gains rather than on local problems. Together with the relevant partners, she will consider measures that both improve public health and are cost effective. On the basis of our findings, we make the following recommendations concerning the new measures.

1. To manage health gains and cost effectiveness, we recommend that the minister carry out a full ex ante social cost-benefit analysis that also considers the non-financial health benefits of each measure. To determine the effectiveness of a measure, the minister needs information on both the health gains and the cost effectiveness.
2. To select the most efficient measures, we recommend that the minister, in consultation with the House of Representatives if necessary, make a clear choice for one method to calculate health gains. The Ministry of I&M currently uses at least two methods: the method used by the RIVM and WHO and the method set out in the Environmental Prices Manual used by CE Delft and others.
3. We further recommend that regular interim evaluations be carried out to generate information on the measures' efficiency and to steer the policy during its implementation. At the very least, evaluations should be carried out within the term laid down in the Periodic Evaluation Regulations (i.e. between four and seven years after introduction).

2.3 Response of the Minister of Infrastructure and the Environment

As part of its joint air-quality audit, the Netherlands Court of Audit commissioned CE Delft (an environmental consultancy) and the National Institute for Public Health and the Environment (RIVM) to carry out a follow-up study of the impact of eight national NSL

measures on emission reductions and health gains. The Court concluded on the basis of this study that the Minister could probably have achieved more in terms of air quality with the same amount of money, and that the same reduction in emissions could have been achieved at a lower cost if she had had advance access to information on the impact of the individual measures.

The NSL is designed as a cooperative programme involving central government and the regional and local authorities. It consists of a comprehensive package of measures aimed at improving air quality (to ensure that the Netherlands complies in good time with the European limit values for particulates (PM10) and nitrogen dioxide (NO2)) and facilitating infrastructural projects. The air quality in the Netherlands has improved significantly since the launch of the NSL. The most recent NSL monitoring report (published in 2017) points to a further decline in the number of outstanding breaches of EU standards on air quality as compared with previous years. The government is currently working on a revised version of the NSL which will contain a series of measures for eliminating any outstanding issues as soon as possible.

The government has also joined forces with a large number of regional and local authorities and partners from different sections of society in order to draw up a new air-quality plan. Its aim is to achieve a lasting improvement in air quality based on public health gains. In formulating the future policy on air quality, the State Secretary believes in the importance of learning from the experiences gained from the current policy. That is why the government is currently conducting a policy review of the NSL.

The policy review will take account of the findings of your accountability audit, which will also play a role in the formulation of the future policy on air quality. The Court specifically recommends carrying out interim evaluations; this point will be included in the new programme. Health concerns will play a more prominent role in decisions on the deployment of the policy instruments envisaged for this programme. The Court's analysis and recommendations are particularly interesting in this context. We will take account of the recommendation to make a clear choice in favour of one method of calculating the health gains of the new measures and to rank them in terms of their cost-efficiency.

I would like to conclude by wishing you good luck with the completion of the joint air-quality audit. I look forward to receiving the joint report with recommendations.

2.4 Afterword Court of Audit

In her response to the section on air quality, the Minister does not make clear whether she is planning to act on our recommendation to carry out a full ex-ante social cost-benefit analysis of the new NSL. She does, however, say that she finds this to be an interesting recommendation in relation to decisions on the deployment of policy instruments in the new NSL. We would like to suggest to the Minister that the new NSL forms an ideal opportunity for implementing the Insight into Quality Operation, the aim of which is to obtain more information on the effectiveness and efficiency of government policy.

Appendix 1
Effectiveness of NSL measures and air quality standards

Effectiveness of NSL measures

On the basis of available evaluations and reports, this appendix considers the effectiveness of the four types of NSL measures: national (generic) measures, local measures, measures relating to the main road network, and measures to promote research and innovation. Little is currently known about the effectiveness of many measures. Air quality standards are considered at the end of this appendix.

Overall picture of the impact of national measures

Most evaluations carried out to date have considered how many people or businesses had used an incentive scheme and whether the measures had increased the use of cleaner vehicles. Records have been kept of the measures' impact in terms of the number of polluting vehicles that have been replaced with cleaner ones or fitted with particulate filters. Some evaluations also assessed the impact on reducing nitrogen dioxide and particulate emissions using average emission factors for different types of vehicle. The measures' impact, however, is rarely expressed as a reduction in *concentrations* of air pollutants. An exception is the national study of the introduction of environmental zones for heavy commercial vehicles in 11 cities (Goudappel, Coffeng & Buck Consultants, 2010). None of the ten evaluations/reports we studied, however, contains firm conclusions on the cost effectiveness of the measures.

The information available on the functioning of the measures presents a mixed picture. Some incentive schemes did not get off the ground or did not achieve the intended results (the particulate filter scheme for mobile machinery (SRMW), the particulate filter scheme for private cars (SRP), the purchasing scheme for heavy commercial vehicles with cleaner, Euro V engines (Euro V scheme), the incentive scheme for new taxis and vans with particulate filters (STB)). The SRP, for example, did not achieve the targets set for it because, on the one hand, most people who were willing to fit a particulate filter for environmental reasons had already done so and, on the other, people thought the cost they had to bear themselves was too high (Tauw, 2009). The Euro V scheme did not come up to expectations because the main reason to purchase a vehicle (for both the manufacturer and the owner) was the introduction of stricter regulations for less environmentally-friendly vehicles. Stricter EU standards, for instance, were about to be introduced and HGV fleets would have become

cleaner anyway without the incentive. Only manufacturers said the scheme had been an extra incentive to purchase a Euro V vehicle but it had not been decisive (DHV, 2007). The scheme for HGV particulate filters (SRV), the national scrappage scheme, the Euro VI scheme for HGVs, and the national environmental zones for HGVs present a more favourable picture. The national scrappage scheme was effective, although many of the cars would have been scrapped at a later date without the scheme (MuConsult, 2010). The reduction in emissions was lower than projected because fewer diesel drivers took part in the scheme than projected.

EU standards set limits on the maximum emission of CO2, HC, NOX and particulates. Stricter EU standards are the most cost effective means to reduce road traffic emissions of NO_2 but they are being introduced in small steps (Netherlands Court of Audit, 2011). And once a new standard has been agreed it can take many years before vehicles that do not comply with it are taken off the roads. Targeted incentives to replace vehicles more quickly and introduce local environmental zones could accelerate the process. When used in combination, regulations (strict limits) and supplementary policy (environmental zones) seem to reinforce each other. A positive example of this is the SRV in combination with environmental zones for commercial vehicles (see Tauw, 2009, and Netherlands Enterprise Agency, 2011). The diesel engine scheme for inland shipping (VERS scheme), by contrast, had no supplementary policy and there were therefore few incentives to fit cleaner engines (V&W, 2009). The same can be said of the SRMW.

Environmental zones for commercial vehicles effectively reduced local air quality problems but there are questions about the enforcement and exemption policy (Goudappel Coffeng & Buck Consultants, 2010). Environmental zones had a positive impact on pollutant concentrations.

1. The introduction of environmental zones for commercial vehicles reduced PM_{10} concentrations from road traffic by between 2% and 7% in 2010. PM_{10} concentrations were 0.02 to 0.08 $\mu g/m^3$ lower than without environmental zones.
2. On the whole, environmental zones have reduced NO_2 concentrations since 2013. NO_2 concentrations from road traffic have fallen by between 1% and 2% and on average are between 0.02 and 0.09 $\mu g/m^3$ lower than without environmental zones.

Nevertheless, the measures' actual impact on concentrations was lower than originally projected. This was due chiefly to the fact that actual vehicle emissions have always exceeded the agreed EU standards. In 2013, the RIVM, the Netherlands Environmental

Assessment Agency (PBL) and TNO together calculated what would have happened if car manufacturers had complied with the agreements on maximum NO_2 emissions (Velders et al., 2013). There were substantial differences in emission levels, with the greatest differences being for medium-sized commercial vehicles: the official emission factors are 93% lower than the actual emissions. Nitrogen concentrations would on average have been 1.4 $\mu g/m^3$ lower if road vehicles had met the EU standards. In large cities with a high density of traffic, the reduction would have been as high as 2 $\mu g/m^3$ (Wesseling & Velders, 2015). In 2015 there would have been virtually no breaches of the NO_2 limit in the Netherlands. These results show that the measure can be very effective if enforced. Virtually no other measure achieved such an improvement in air quality.

Overall picture of the impact of local measures

Calculating the impact of local measures in terms of emission or concentration reductions is not always possible or meaningful. However, the NSL monitoring tool can calculate the impact of about a third of the local measures, partially calculate the impact of just over a third and cannot, or only with great difficulty, calculate the impact of the final third.

How well can the NSL monitoring tool calculate the impact of location specific measures?

Measures that the NSL monitoring tool can quantify with little difficulty include those that improve traffic circulation (by means of hardware and software) and noise barriers along motorways. Those that are more difficult to quantify include behavioural measures and measures to encourage the use of public transport. It might seem reasonable to assume that such measures will have a positive impact on air quality but it is difficult to quantify. The impact of the provision of public information and the promotion of research are two measures that cannot be quantified. Green measures, such as planting trees, green areas and living walls, usually sound sympathetic and they can definitely have a positive impact on the quality of life in urban areas, but they do not lead to any real improvement in air quality.

Several sources (e.g. Goudappel Coffeng & Buck Consultants, 2010; Audit Offices of Amsterdam, The Hague, Rotterdam & Utrecht, 2011; TNO, 2016) conclude that local measures such as environmental zones and clean buses have a positive and quantifiable impact on air quality. The municipality of Utrecht commissioned a report from TNO on the emission performance of clean buses and the impact of the city's environmental zone on emissions from private and commercial vehicles. It found that the environmental zone had reduced emissions of PM_{10} and $PM_{2.5}$ and soot by 5%, 19% and 20% respectively

(TNO, 2015). Soot (elemental carbon) is an ultrafine particle that can penetrate the lungs more deeply and is therefore more harmful to health. The impact on NO_2 emissions was negligible, 1%-2%. Finally, the environmental zone in Utrecht had very probably had a positive impact on *concentrations* of particulates and soot. A reduction of 16% was calculated. The fact that the reduction in soot concentrations in Amsterdam and Rotterdam, which have not introduced environmental zones for private and commercial vehicles, was lower than the reduction in Utrecht would seem to confirm this conclusion.

Overall picture of the impact of measures relating to the main road network
Less money was spent on the main road network than budgeted because fewer barriers were built in locations where the limits were already achieved. Some measurement points were also relocated (Arcadis, 2015). The impact of barriers has not been demonstrated by measurements taken before and after their construction. The reduction in concentrations of particulates and NO_2 could have been due to lower background concentrations during the year.

Other NSL measures originally planned for the main road network, such as traffic circulation measures, tunnels and temporary lower speed limits (80 and 100 km/h zones), were not implemented as part of the NSL. Circulation measures and tunnels can have a positive impact on air quality but are difficult to isolate from other factors, such as accessibility and improved quality of life. The termination of the Paying Differently for Mobility project led to the introduction of other measures, such as the incentive scheme for cleaner HGV and bus engines and the tax discount for Euro 6 cars.

An RIVM study of the increase in the speed limit to 130 km/h on certain motorway sections following a motion in the House of Representatives supported by the Ministry of Infrastructure and the Environment (I&M) found that on the whole there was only a limited risk of the NO_2 limit being breached. This was partly because vehicles had become cleaner. The higher speed limit led to a deterioration in air quality at 5.5% of the 71,259 locations in comparison with 2015 but concentrations were still within the EU limits (Wesseling, Van Zanten & Nguyen, 2016). Although there has been no increase in particulate emissions, air quality in the Netherlands has deteriorated in absolute terms since the introduction of higher speed limits. A TNO study found that Euro 6 diesel cars emitted 15% more nitrogen dioxide on a 130 km/h motorway with normal circulation than on a 120 km/h motorway, and 47% more than on a 100 km/h motorway.

Overall picture of research and innovation measures

The air quality innovation programme tested many measures (vegetation, road surface cleaning, filter cloth, canopies) but most of them were less effective than anticipated on the basis of literature and laboratory research (Rijkswaterstaat, 2009). The air scrubbers programme for the poultry industry, the main source of agricultural particulates, found that air scrubbers did not produce the expected reduction (I&M, 2013).

Air quality standards

The NSL consists of measures designed to achieve compliance with the nitrogen dioxide (NO_2), particulate (PM_{10}) and fine particulate ($PM_{2.5}$) limits. The EU air quality directive 2008/50 and the four secondary directives (2007/107/EC) also include standards for permissible concentrations of other atmospheric particulates to protect public health and nature (e.g. SO2, arsenic, lead and the like). As the Netherlands already satisfies the standards, the NSL does not include measures to achieve them. The EU NEC directive (2016/2284/EC) also lays down emission standards.

The EU has set limits and targets for nitrogen dioxide (NO_2), particulates (PM_{10}) and fine particulates ($PM_{2.5}$). Since 1 January 2015, the $PM_{2.5}$ targets have been laid down in European standards and exposure criteria. An annual limit and a daily limit have been set for PM_{10}. The daily limit for particulates is 50 $\mu g/m^3$ and this limit may be exceeded 35 times per annum at most. The annual concentrations are calculated for the Netherlands as a whole. The World Health Organization's recommended limits for particulates are based on the health impact and are roughly half the EU limits.

Table 4 *Advisory values and limits for nitrogen dioxide and particulates*

Pollutant	WHO (annual average)	EU (annual average)
Nitrogen dioxide (NO_2)	40 $\mu g/m^3$	40 $\mu g/m^3$
Particulates (PM_{10})	20 $\mu g/m^3$	40 $\mu g/m^3$
Fine particulates ($PM_{2.5}$)	10 $\mu g/m^3$	25 $\mu g/m^3$

The annual NSL monitoring reports also present the results of checks of limits below the standard. The RIVM uses a limit of 38 $\mu g/m^3$ for nitrogen dioxide and a maximum breach of 30 days of the daily limit for PM_{10}. Such breaches are referred to as 'near-breaches'.

Information

The Netherlands Court of Audit
Communication Department
P.O. Box 20015
2500 EA The Hague
The Netherlands
+31-70- 342 44 00
voorlichting@rekenkamer.nl
www.rekenkamer.nl

Cover

Design: Corps Ontwerpers
Foto: Fotograaf/Stockbureau

The Hague, January 2019