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Evaluation of cost-effectiveness of Dutch domestic climate policy

1999-2004

Executive summary

Executive summary of the Dutch report: "Evaluatie doelmatigheid binnenlands klimaatbeleid: Kosten en effecten, 1999-2004"

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Executive Summary

Background to this study
In accordance with the Kyoto Protocol the European Union has committed itself to reducing its overall greenhouse gas emissions by 8% between 2008 and 2012 relative to 1990 levels. Under the so-called Burden Sharing Agreement this target translates to a 6% cut in emissions for the Netherlands. Half this figure – about 20 Mtonnes according to latest estimates – the Dutch government seeks to achieve domestically, with the rest being secured by purchasing ‘carbon credits’ for emission cuts achieved in other countries under the Clean Development Mechanism (CDM) and Joint Implementation (JI).

The Netherlands’ Climate Policy Implementation Plan (CPIP; 1999) provides for two interim reviews, in 2002 and 2005, to assess whether policy progress and emissions reduction are on track for securing the 2008-2012 target. The government is to report the results of the second of these reviews to parliament in its 2005 Climate Policy Assessment Report.

One element of this review is an ex-post analysis of the efficacy and cost effectiveness of climate policy during the period 1999-2004. In early 2005 the Energy Centre of the Netherlands, ECN, had completed its study of policy efficacy, i.e. the impact of climate policy on CO_2 emissions. The Dutch Environment Ministry, VROM, subsequently commissioned CE to conduct an ex-post analysis of the (cost-)effectiveness of *domestic* climate policy to date, reviewing not only costs but also the policy efficacy of non-CO_2 greenhouse emissions. In conducting this review CE has collaborated with ECN with the key aim of ensuring methodological consistency between calculations of impact and cost. Responsibility for the final results lies with CE.

Aim of the study
The aim of this study is twofold:
1 *To provide insight into the effectiveness of Dutch domestic climate policy during the period 1999-2004 and the cost to government as well as to individual ‘target groups’ per unit CO_2-equivalent avoided under that policy.*
2 *To identify lessons for the future from experience with climate policy between 1999 and 2004; could policy targets have been secured at less expense, or better results achieved with the same level of funding?*

As part of the second of these aims it was also examined whether greater synergy might be achieved between climate policy and policy to tackle regional air pollution (i.e. substances covered by the National Emissions Ceiling directive, plus particulates), thus to improve overall policy efficacy and ensure greater cost effectiveness.

Scope and methodology

In assessing the effectiveness of climate policy, two levels can be distinguished:

1 The individual programmes, policies and measures implemented by a variety of government departments.
2 The overall policy package, coordination of which is the responsibility of the Environment Ministry.

The present study focuses on the second level, assessing the effectiveness of the policy package as a whole. This means the impact of Dutch domestic climate policy has been reviewed at the national and sectoral level. This report does not therefore attempt to assess the effectiveness of individual measures, programmes and policy tools, although the results of such assessments are included where relevant.

The factual basis for the cost calculations in this study consists of previously published reviews of the three sectors (Built Environment, Transport and Non-CO_2 emissions) the aforementioned ECN policy efficacy review, and additional data provided by the National Institute for Public Health and the Environment, RIVM, and Netherlands Statistics, CBS. One important requirement was to enable comparison between the results of these various studies, which are characterised by major differences with respect to, *inter alia*, calculations of policy impact, time period, cost categories considered and the accounting methods used to translate climate policy expenditures into costs.

To achieve such comparability of results and make up for lack of data it was necessary to make additional calculations of our own using the raw, sectoral data. In doing so, we have endeavoured to motivate and document our choices as robustly as possible.

The basic premises of this study can be summarised as follows:

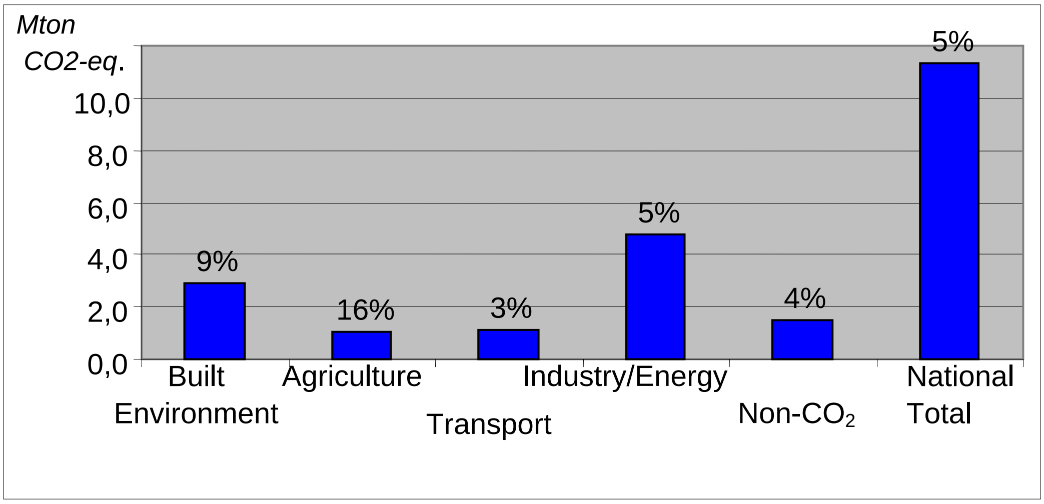
- Quantitative review for the years 1999 through to 2003, with impacts in 2004 assessed only qualitatively for lack of quantitative data while the project was underway.
- Only those policies were included which (a) had the primary aim of reducing greenhouse gas emissions, saving energy or promoting renewable energy, and (b) were indeed associated with costs *and* effects in the period 1999-2003.
- In calculating cost effectiveness, five categories of cost were distinguished: investment costs, operation and maintenance costs, administrative costs, subsidy payments and revenues (i.e. negative costs) from energy saving.
- Cost effectiveness was analysed from three perspectives: government costs, end-user costs and costs to the national economy.
- Five sectors (climate policy ‘target groups’) were distinguished: Built Environment (household/commercial), Agriculture, Transport (freight, passenger), Industry/Energy, and Non-CO_2 emissions.
- Depreciation calculated according to the VROM “Cost effectiveness methodology” where investments in buildings are distinguished from investments in plant and equipment.

- Sector-specific discount rates were used, again as per the VROM protocol, not only for costs to end-users but also for those to the national economy, with all costs, revenues, expenditures and income converted to 2004 prices.
- In reviewing subsidy schemes, due correction was made for free-riders, i.e. beneficiaries who would also have invested without the subsidy, for both costs and effects.
- The impact of Dutch climate policy on regional air pollution (acidification and particulate emissions) was estimated quantitatively to identify any synergies; the inverse impact of acidification policy on climate policy was examined in qualitative terms only.

Policy impact

From 1999 to 2003 Dutch climate and energy policy induced a greenhouse gas emissions reduction of 11.4 Mtonne. Of this figure 1.5 Mt could be ascribed to reductions in non-CO_2 emissions, 8.1 Mt to energy conservation and 1.7 Mt to use of renewable energy. The impacts of energy saving and renewable energy calculated in the present study are consistent with those derived in the aforementioned ECN efficacy analysis (ECN, 2005a).

Figure 1 Impact of Dutch climate policy, 1999-2003, absolute and as a percentage reduction of sectoral emissions in 2003



NB: Percentage emission reductions relate calculated policy impact (in *primary* energy consumption avoided) to emissions according to the 'target value method' (in *final* energy consumption avoided) and thus provide no more than a rough indication of the comparative impact in each sector.

Figure 1 shows the calculated percentage emission reductions for the various sectors relative to their 2003 emissions. As can be seen, in absolute terms the greatest cuts were achieved by Industry/Energy and in relative terms by Agriculture and Built Environment. In Transport and Non-CO_2 there were only modest emission reductions, both absolute and relative.

National cost effectiveness

At the national level, the policies in place between 1999 and 2003 had an estimated cost effectiveness of € 40-90 per tonne avoided CO_2. The cited range is mainly a reflection of the data spread in the sources consulted and is due to a variety of uncertainties about the costs associated with certain policies (investments, maintenance) and in the case of subsidy schemes free-rider effects. This said, though, we suspect the upper bound is a better estimate of actual cost effectiveness.

Table 1 National cost effectiveness of climate policy measures, 1999-2003, €/t CO_2 (2004 prices)

	Built environment	Agriculture	Transport	Industry /Energy	Non-CO_2	National total
Cost effectiveness	20 to 70	2 to 20	-30 to -25	90 to 170	10	40 to 90

The sectors vary considerably in the cost effectiveness of the measures implemented in the period under review (Table 1). In the Transport sector the cost of abatement measures was more than recuperated, i.e. their cost effectiveness was negative. Agriculture and Non-CO_2 measures were also comparatively cheap, with reductions in Built Environment and above all Industry/Energy proving the most expensive. The high abatement costs in Industry/Energy are due entirely to the use of renewables for primary generation. The average cost effectiveness of renewable energy can be as much as € 300 per t CO_2 avoided, over seven times the national cost figure for energy-saving measures (upper bound: € 40/t CO_2). In Industry, energy conservation has an even higher cost effectiveness of about € 25 per t CO_2 avoided.

We thus conclude that measures in Agriculture, Transport, Non-CO_2 and Industry (excl. primary energy supply) were comparatively cheap, with abatement costing less than € 25 per t CO_2 avoided. Measures in the Built Environment sector were less cost-effective, while application of renewable energy was extremely expensive.

Government expenditures

During the period 1999-2003, total government expenditure on climate policy amounted to over € 4.6 billion (in 2004 prices). Of this figure, € 2.0 billion went to incentives for renewable energy, € 2.1 billion to energy conservation and € 0.4 billion to implementing the various schemes. Less than € 0.1 billion was spent on reducing non-CO_2 emissions.

Of the expenditures on renewable energy, an estimated € 0.4 to 0.6 billion leaked away from the Dutch economy via incentives for imports of foreign-generated renewable energy. In 2003 and 2004 these particular incentives (REB36o and REB36i) were discontinued and re-engineered into the so-called MEP scheme (*Milieukwaliteit Elektriciteitsproductie*) that has no such leakage. As extra imports of renewable power from abroad substitute mainly for other forms of electricity imports (fossil and nuclear), it seems unlikely that any domestic cuts were achieved in this way, as would have been the case if they had led to less demand for domestically-generated (fossil) power. The issue of whether these Dutch incentives had any impact abroad was not investigated in this study.

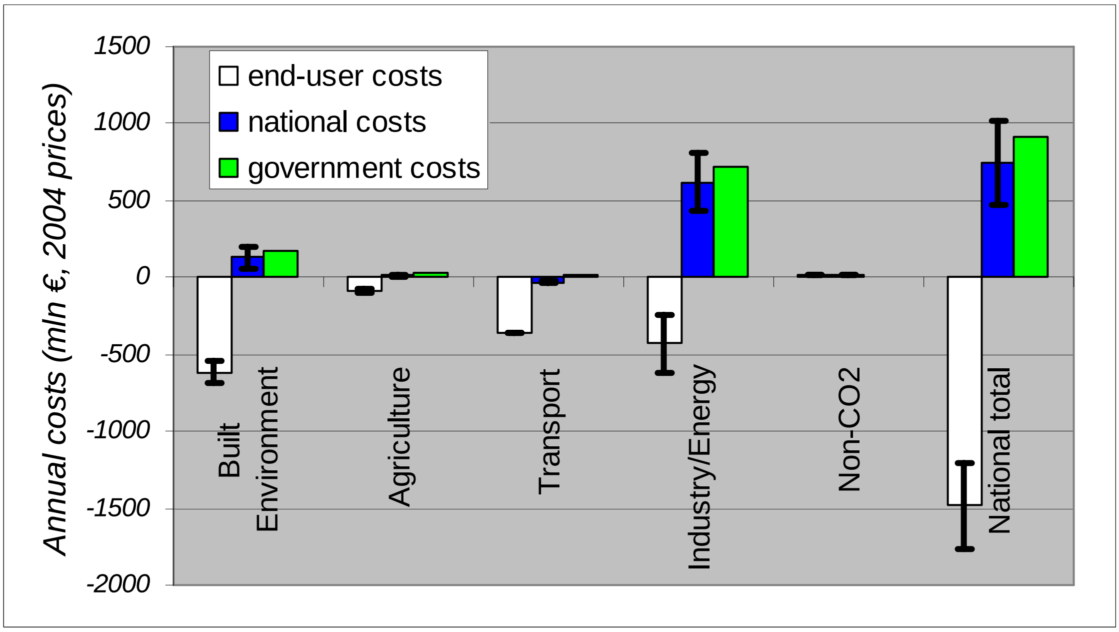
This foreign leakage of subsidies affected the overall cost effectiveness of climate policy at the national level. In calculations of national cost effectiveness, subsidies are normally regarded as transfers rather than costs, the funds merely changing hands rather than vanishing. However, transfers abroad do need to be taken as costs to the Dutch economy and were therefore included in the national cost effectiveness data presented above. If the government had not provided incentives for foreign-generated renewable power, national cost effectiveness would have been about € 10-15 per t better (€ 30-75 per t CO_2).

Overall government expenditure on subsidy implementation amounted to about 10% of outgoing subsidies, with relatively high administrative costs for Built Environment (where the target group comprises a vast number of small-scale users) and Industry (where long-term energy efficiency agreements are in place). These figures do not include the costs of policy development at government ministries or provincial executives.

Review of costs to target groups

Figure 2 reviews abatement costs to the various sectors from three perspectives: end users, the government budget and the national economy. These are expressed in annual terms, with investments and subsidies converted to annual costs and revenues. These figures can be regarded as the total costs in 2003 of climate policy efforts from 1999 to 2003.

Figure 2 Annual costs of climate policy efforts, 1999-2003; average values, with assumed ranges in black



As the figure shows, end users implementing climate measures made a net *profit* on balance. In other words, returns from energy conservation plus subsidies received together exceeded the cost of abatement measures. In 2003 the aggregate revenues accruing to end users totalled approximately € 1.5 billion. Relative to the reductions achieved, users in the Built Environment and Transport benefited particularly from taking action. This is because energy is taxed relatively heavily in these two sectors, so that end users made an additional saving on reduced taxes and charges. On this point we note that in this study the reduced tax revenues associated with these energy savings were not included under government costs.

The analysis of this study leads to the conclusion that, by and large, the government co-financed the costs of the climate measures taken by the various sectors to a very substantial extent via a wide variety of subsidy schemes. The only exception in this respect was Non-CO_2 emissions, where end users did incur costs to secure targets. In contrast to the situation for CO_2, measures to reduce these emissions are not associated with any real returns, if at all, as there are few direct savings on energy and/or resources.

However, this analysis does not warrant the conclusion that the government should discontinue the subsidy schemes in question. Without subsidies, the only climate measures that would be cost-effective – and thus economically rational – are those under the headings Built Environment and Transport. In every other sector, in the absence of subsidies far fewer measures would probably have been implemented.

It is also to be queried whether the cost effectiveness calculated for Transport and Built Environment are a true reflection of actual consumer behaviour. In accordance with the VROM “Cost effectiveness methodology” in our calculations costs were written off over 10 to 25 years, probably much too long for consumer investment decisions. Studies have shown, for example, that people buying a new car generally only include fuel use in the first two or three years in their cost calculations. In these sectors, then, the existence of subsidies may well have helped lower the threshold for implementing climate measures without there being any question of ‘over-subsidisation’.

A final reason for the high government costs was the existence of free-rider effects as well as subsidy leakage to foreign economies. To plug these gaps, as of 1 January 2003 a number of steps were taken to modify the schemes in question. Thus, in 2003 and 2004 exemption of foreign-generated renewable energy from the Regulatory Energy Charge was gradually retracted, and since 2003 the terms of a number of investment schemes have been modified to limit the free-rider effect. This is the case with the EIA scheme providing tax breaks for energy investments (where categories most prone to free riders have now been explicitly excluded) and the VAMIL scheme allowing accelerated write-off of environmental investments (where energy investments were excluded in 2003). Finally, the EPR energy rebate scheme was modified in 2003 (with fuel-efficient cars and solar panels being removed from the list) and subsequently virtually abolished in 2005.

Although these changes may well reduce government costs substantially, no estimate of this impact can be given as yet.

Synergies with acidification policy

For a robust comparison of the (cost) effectiveness of domestic and foreign climate measures, any impact they have on other areas of environmental policy should be duly accounted for. In this study we considered two specific areas to this end: regional air pollution and acidification.

In the case of energy conservation and renewable energy, in the period under review we identified synergies amounting to a 1-4% reduction in emissions of VOC, PM_{10}, NO_x and SO_2 (Table 2). Non-CO_2 measures had a limited impact on NH_3 and NO_x emissions, which was not quantified in the present study.

Table 2 Reductions in other pollutant emissions (ktonne) due to climate policy 1999-2003 and avoided prevention costs (mln. €, 2004 prices)

	Reduction due to climate policy	Percentage relative to 2002 emissions	Avoided prevention costs
NO_x	14.72	3.7%	83
SO_2	2.72	4.1%	13
VOS	1.65	0.7%	1.5
PM_{10}	0.79	1.8%	2

In this policy area approx. € 100 million prevention costs were avoided, mainly through cuts in NO_x and to a lesser degree SO_2 emissions. For comparison, this is equivalent to about 12.5% of the calculated annual national costs of climate policy. This figure for avoided prevention costs is in fact an underestimate, it may be added, because of rising prevention costs under (progressive) European urban air quality standards.

These synergies may be justifiably deducted from the calculated cost effectiveness of domestic climate policy, the (national) cost effectiveness of which then improves by about € 10 per t, putting it in the range of € 30-80 per tonne CO2.

Conversely, though, acidification policy probably has a far smaller impact on the climate situation and in fact probably leads to a net *increase* in CO_2 emissions because of higher energy consumption. In this study we did not attempt to estimate this impact quantitatively.

Main observations and recommendations on cost effectiveness of future climate policy

Equipped with the results of the cost effectiveness analysis, we also examined whether any recommendations should be made regarding the modalities of future climate policy. In doing so, we considered how the present array of policies might be made more cost-effective as well how a different policy mix might be employed to the same end.

It should be borne in mind when reading these recommendations that the cost effectiveness data calculated in this study are not the be-all and end-all of policy design. In the first place, there are other important policy considerations such as fair allocation of targets and efforts across sectors as well as aspects relating to security of energy supply. Secondly, the cost categories considered here are not exhaustive, with indirect effects such as lost (or enhanced) competitiveness due to implementation of climate measures being ignored, for example.

The following recommendations are of two kinds, geared to improving national cost effectiveness and reducing government costs. A broader set of recommendations is provided in Chapter 8.

National cost effectiveness

- Comparison of ex-ante costs, as per the government's Climate Policy Implementation Plan with the ex-post costs calculated in this study shows that the latter are probably higher. This indicates that Dutch climate policy has not been as cost-effective as envisaged. Part of this difference is due to the costs of renewable energy being estimated lower ex-ante than in the present study.
- In sectors where low-cost measures were available (Transport, Non-CO_2 emissions) there was relatively little government spending. This is another indication that policy efforts were probably not as cost-effective as they might have been, had they been geared to making use of the cheapest options. The question remains, though, whether and to what extent such reductions are indeed amenable to policy.
- Greater emission reductions in the Non-CO_2 'sector' would, in all probability, have brought down the overall national costs of domestic climate policy between 1999 and 2003. In that period this was the only sector where end-users were subject to net abatement costs. It should therefore be examined whether greater reductions might be achieved through more focused targeting of subsidies to this particular sector.
- Similarly, greater emission reductions in the Transport sector might have led to somewhat lower costs at the national level. Studies have shown that it is technically and economically feasible to reduce transport CO_2 emissions by 25-33% using (more than) cost-effective technologies that have no impact on vehicle performance, space or safety. These findings were confirmed by the results of the present ex-post analysis. In practice, however, it proves difficult to achieve the reductions theoretically available, because non-cost factors like status, speed and comfort are also important in the decisions of vehicle buyers and users. With additional fuel-saving incentives in place for the

transport sector, some of the theoretically available scope for cost-efficient action might have materialised.

- Finally, we conclude that greater focus on energy conservation rather than renewable energy would have also led to lower costs. At the same time, though, political parties and society at large are continually advocating greater use of renewables, based partly on issues like the finiteness of fossil resources and the need for a more general energy transition in the context of sustainable development. In the process, the associated costs often remain rather in the background, in the media as well as in the political debate.

Government costs

- Subsidies were the main instrument employed in Dutch climate policy between 1999 and 2003. Two-thirds of overall government expenditure on environmental policy in this period went to subsidies for climate control measures and to administrative costs associated with those schemes. As this ex-post analysis shows, in some sectors relatively high subsidies were required to induce parties to invest in emission reduction. This is due partly to the inefficiency of certain markets. When it comes to energy conservation, for example, home-owners and families are by no means always rational in their cost-benefit decisions and because of market imperfections even businesses do not always make the most cost-effective decisions (for lack of information, for example). Given these inefficiencies, it may be more attractive from the angle of cost effectiveness to fine-tune the subsidy structure or opt for a different instrument altogether, such as emission standards. Tightening the energy performance standards (EPN) for buildings from 1.4 to 1, for example, meant only minimal additional costs to end users. Given the empirical trend to postpone new investments for as long as possible by keeping old plant and equipment up and running, it is also very important that energy conservation policy hooks up to natural cycles of change. As an example, most energy-saving investments in greenhouse horticulture relate to new facilities.
- The cost effectiveness of subsidies can be improved by integrating them more with tax rebates or tangible purchase of goods and services. Economic-psychological studies indicate that people attach seven times more value to a sum of money paid (or not paid) than to a sum received. Post hoc reimbursement is thus significantly less effective than any discount on payment.
- Additional cost reductions may be feasible through (limited) integration of the policy themes acidification and climate change. One option would be to introduce a statutory commitment, for all plans and specific policies relating to these themes, to identify any synergies between the two. This does not occur at all at present, we would note. Using this information, for certain specific policies consideration might then be given to some form of integration. Transport and Industry are probably the most likely candidates here, one obvious area being measures to reduce vehicle kilometrage, i.e. traffic volumes.
- Finally, we recommend that in designing future policies and carrying out ex-ante calculation of their cost, greater allowance be made for the cost of the

learning process, i.e. for individual policy design errors and other unforeseen issues, and for the free-rider effect in the case of subsidies.

Using the results of this study
The results of the present study can usefully serve a variety of purposes: as an aid in new policy formulation; to compare ex-ante cost estimates with the ex-post results reported here; to compare the costs of domestic climate measures with those under JI/CDM, i.e. 'flexible mechanisms'; and to enable international comparison with (the cost effectiveness of) policies elsewhere.

In applying the results, the following points should be duly noted:
- As already remarked, leakage of (REB) subsidies abroad had a substantial impact on the overall cost effectiveness of domestic climate policy. As these leakages had already been plugged by the government midway through the period under review, in assessing future climate policy options we feel it would be better to work with a cost effectiveness figure corrected for this leakage. If these foreign transfers are omitted from the calculations, it can be concluded that during this period the cost effectiveness of Dutch domestic climate policy efforts was between € 30 and € 75 per tonne CO_2-equivalent avoided. Given the numerous steps taken by the government to redress these issues in 2003 and 2004, this corrected figure is a better point of departure for future calculations.
- Any comparison of domestic climate policies with policies to secure reductions abroad (JI, CDM) should make due allowance for additional synergies of the former in other areas of environmental policy. In this study this improved the ex-post, i.e. calculated, cost effectiveness to € 20-65 per t CO_2 (including correction for the foreign leakage just cited). Every effort was also made to ensure the methodology of this study dovetailed as well as possible with that used for calculating the cost effectiveness of JI and CDM measures. When comparing the overall costs of JI/CDM and domestic climate measures it should also be remembered that targets under the former are cumulative while those under domestic policy are not.
- When comparing the results of this study with experiences in other countries and the results of other studies it should be borne in mind at all times that our analysis is based on five specific cost categories: (i) investment costs, (ii) operation and maintenance costs, (iii) subsidy payments, (iv) government administrative costs and (v) revenues (negative costs) from energy savings. Equally important is the methodology used to compute cost effectiveness and in particular how expenditures have been converted to annual costs. In the course of this study we encountered major differences among the methods used in the various studies that may have a substantial impact on estimates of cost effectiveness.

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