HOW EFFECTIVE ARE GREENHOUSE GAS REDUCTION POLICIES IN THE NETHERLANDS?

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Abstract: *The first policies aimed at reducing emissions of greenhouse gases in the Netherlands date from the early 1990's. The fruits of those policies are beginning to become visible in absolute emission reductions, particularly as regards CH_4 and the f-gases. There has as yet been no breach in the trend of growing CO_2 emissions, although both CO_2 emissions and energy use have grown less rapidly than the economy. The extent to which this can be attributed to policies is as yet unclear. Ex post evaluations of policy effectiveness are becoming increasingly important in the Netherlands, but difficult methodological issues remain to be resolved.*

1. Introduction

This paper goes into Dutch experiences with assessing the effectiveness of greenhouse gas emission reduction policies. Ex ante assessments of the emission reduction potential of measures have been carried out at regular intervals since the early 1990's, when the first national targets for reducing greenhouse gas emissions were set in successive National Environmental Policy Plans. Results of an ex ante assessment currently underway, which addresses the question of whether we are still on track for meeting our Kyoto commitment, will be reported to Parliament early in 2002.

Experience with ex post evaluation of policies is relatively limited but is becoming increasingly important with the introduction of a new system of policy accountability in the Dutch national government. Under the new system ministries must set operational policy targets (for example, in terms of emission levels or emission reductions in the case of climate change policy) in their yearly budgets and must submit to Parliament an annual accounting of efforts to achieve those goals. New guidelines requiring government departments to carry out ex post evaluations of policies at least once every five years, and setting quality standards for those evaluations, will go into effect on January 1, 2002.

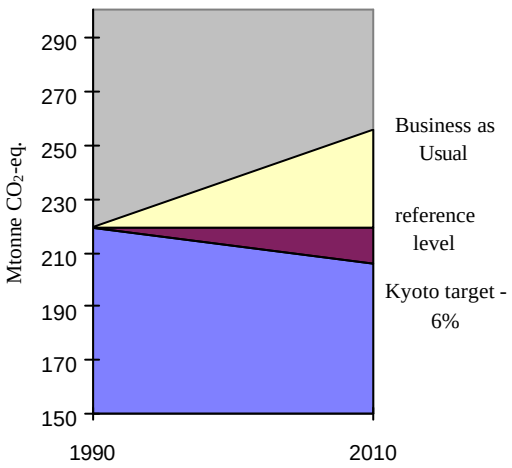
Following some background information about the history of climate change policies in the Netherlands and the development of emissions over the past ten years, the paper summarizes available information regarding the effectiveness of climate change policies thus far. The paper then outlines some of the lessons that have been learned from ex ante assessments over the past ten years and closes with a short sketch of some of the methodological issues we are struggling with as we attempt to improve and refine our ex post evaluations of policy effectiveness.

2. Background

The Netherlands first took steps to reduce emissions of greenhouse gases in the early 1990's. Initially these steps consisted largely of 'no regrets' measures, taken primarily to address concerns other than climate change (such as security of energy supply, acid rain, solid waste disposal, etc.), but including among their benefits impacts on emissions of greenhouse gases. In 1999, following the agreements reached in Kyoto and the European Union, policies were stepped up significantly in the Netherlands' Climate Policy Implementation Plan (NCPIP). The policies in the plan go beyond 'no regrets' and were

adopted with an eye to reducing emissions to the level required by the Kyoto Protocol (6% under the 1990 reference level or 206 Mtonnes CO_2 -equivalent, a reduction of 20% in 2010 compared to emissions in the Business as Usual scenario; see Figure 1). The policy effort was split evenly between measures to reduce emissions within the Netherlands, and utilization of the Kyoto mechanisms to effect emission reductions abroad. This split in the policy effort means that the operational target for assessing policies has two elements: domestic emissions in the budget period need to average no more than 231 Mtonnes per year, and acquisition of credits abroad during the budget period need to average 25 Mtonnes per year.[1] Based on ex ante assessments carried out when the plan was drawn up and given the projections in the Business as Usual scenario which formed the basis of the policy analysis, it was believed that the effect of the policy package presented would be sufficient to reduce emissions to the required level. However, given the uncertainties associated with long term projections, it was also decided to carry out evaluations of climate change policies in 2002 and 2005. The 2002 evaluation will be sent to Parliament in the first quarter of next year.

Figure 1: The Kyoto target relative to the Business as Usual scenario



3. What is 'best practice' in the Netherlands?

The criteria used in putting together the basic policy package in the NCPIP have been described elsewhere[2]. In the Dutch situation best practices are those policies and measures which, taken together, are cost-effective, spread the effort in a balanced way across target groups, encourage structural changes which reduce CO_2, include monitoring, evaluation and contingency planning, and allow target groups flexibility in what actions they take while assuring that results are achieved.

In the Netherlands these criteria have led to emphasis on negotiated agreements with target groups, facilitated by instruments intended to lower barriers and correct market failures. These secondary instruments consist of market-oriented instruments such as taxes and fiscal incentives, regulations pursuant to the Environmental Management Act, and subsidy and information programs.

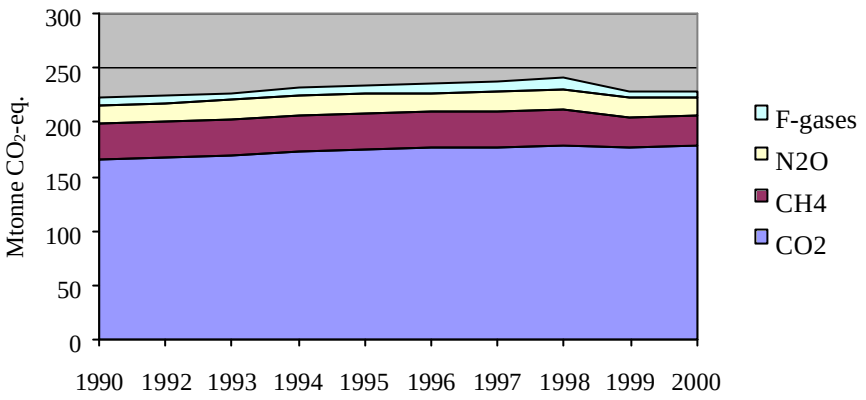
[1] This operational target is subject to change due to improvements in the national system of emission inventories following adoption of the IPCC Good Practice Guidance. Pursuant to international agreements the assigned amount associated with the –6% target will be determined in 2007.

[2] See Merrilee Bonney, *Climate Change Policies in the Netherlands: Analysis and Selection*, presented at UNFCCC Workshop on Best Practices in Policues and Measures, Copenhagen, April 2000.

4. How have emissions developed over the past decade?

Total emissions grew steadily beween 1990 and 1998 after which the first decline (by 6 Mtonnes CO_2-equivalent, or 3%) occurred between 1998 and 1999. That decline continued in 2000 (by 1 Mtonne, or 0.5% between 1999 and 2000), but it is still too early to conclude that this is the beginning of a trend that will continue into the future.

Figure 2: Developments in emissions of greenhouse gases 1990-2000[3]



The slight drop in CO_2 in 1999 was due largely to two factors outside the influence of climate change policies. With the liberalisation of European energy markets, imports of electricity jumped significantly, reaching the maximum level that can be physically handled by the grid. Dutch power plants cut back on production as a larger share of the (still growing) demand for electricity was met by foreign producers. 1999 also saw very low world oil prices. Since the price of natural gas is coupled to that of oil in the market, gas prices also dropped. Power plants in the Netherlands used less coal and more natural gas for the kilowatt hours that they did produce. In 2000 CO_2 emissions rose again by about 1%. Although import remained at the maximum level possible, there was a renewed emphasis on coal as oil and gas prices rose significantly above their 1999 levels. 2000 also saw continued, but moderate, growth in the demand for energy in industry, households and the traffic sector.

Emissions of the non-CO_2 greenhouse gases declined significantly over the past two years (by 10% in 1999 and 5% in 2000). Methane emissions from waste disposal have been decreasing for a number of years because more methane being recovered from landfills and there has been a fall in the amount of organic waste being landfilled. This trend continued in 2000. Emissions of HFC's and PFC's have declined significantly due to measures taken at a small number of industrial facilities: installation of an afterburner at a facility for the production of HCFC's and process adjustments at one of the Netherlands' two producers of primary aluminum.

5. How has policy influenced emissions over the past decade?

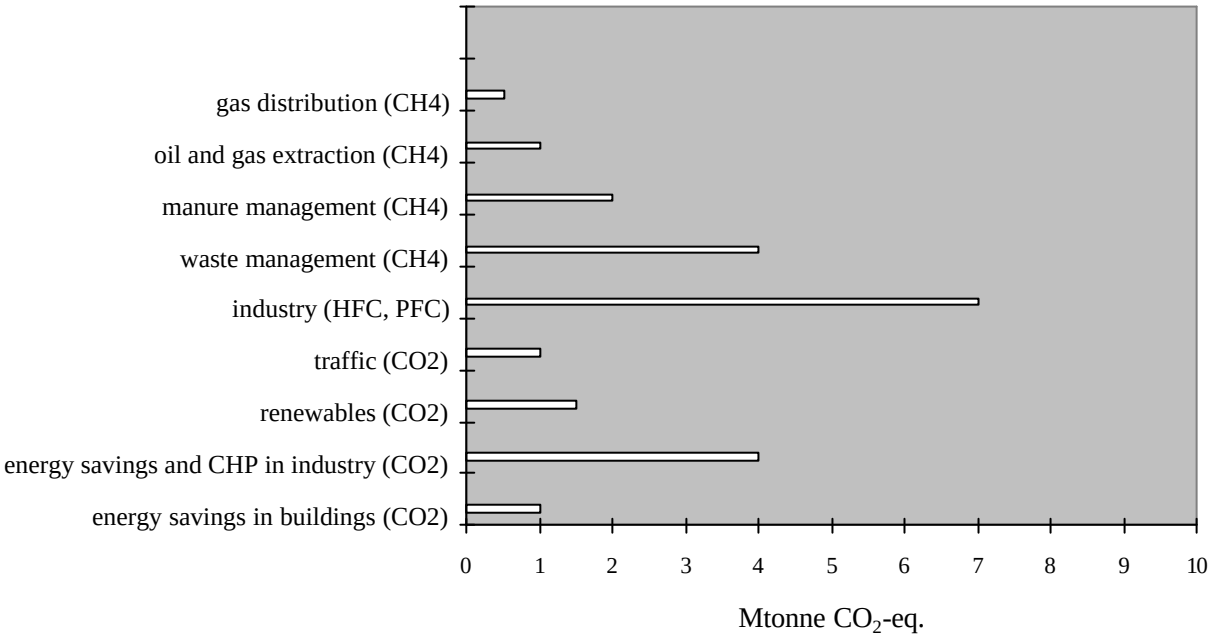
Policies directed at the non-CO_2 gases are beginning to bear fruit. 'No regret' policies in the area of waste management and agriculture have contributed to reducing CH_4 emissions, and measures taken at industrial facilities and oil and gas wells have reduced emissions of HFC, PFC and CH_4. The National Institute for Public Health and the Environment[4] has concluded that in the absence

[3] CO_2 emissions in the figure have been corrected for annual fluctuations in temperature.
[4] National Institute for Public Health and Environment (RIVM), *Milieubalans 2001*, September 2001, 167 pages.

of those policies, emissions of the non-CO_2 gases would have been higher by more than 35% in 2000.

Given the growth in CO_2 emissions over the past ten years, one might be tempted to conclude that CO_2 policies are not having much effect. After all, the CO_2 decline that occurred in 1999 was explained by energy prices and electricity imports, developments outside the sphere of the CO_2 reduction policies being pursued in the Netherlands. However, it would be premature to conclude that CO_2 policies are having no effect. In spite of many methodological difficulties in trying to quantify the impact of policy on actual emissions (see paragraph 7) , there is evidence to suggest that without the policies pursued during the 1990's to encourage energy savings and the use of renewables, CO_2 emissions in 2000 would have been 4% higher than they were.

Figure 3: Emissions avoided due to policies in 2000, in Mtonnes CO_2-eq.



Source: National Institute for Public Health and the Environment

The impact of the stepped up policies announced in 1999 in the NCPIP is, of course, not reflected in these numbers. The increased policy effort will not have a discernible for a number of years. The lag time between the decision to pursue a given policy and the occurrence of a measurable effect in practice can be as long as five or six years, due to the time it takes to develop and implement the new policy and to the response time in the market (turnover of capital stock, etc.).

6. Ex Ante Assessments: what have we learned?

Experience with ex ante assessments of policy effectiveness in the Netherlands dates back more than a decade. Important lessons drawn from this experience include the following:

Predicting the future is an uncertain business

In the Netherlands, scenario's play a large role in selecting the policies to be pursued and in addressing the question "Are we on track for meeting our commitments under the Kyoto Protocol?". However, scenario's are uncertain and sensitive to underlying assumptions, particularly in the area of greenhouse gas emissions, where economic parameters which are notoriously difficult to predict have a large impact on emissions. In looking back on our past ex ante assessments, we have learned that we are not really very good at predicting how the economy or energy markets will develop over the long term.

A study carried out by the Netherlands Bureau for Economic Policy Analysis (CPB)[5] illustrates how far off we have been when projecting key economic parameters in the past. The study looked into the causes underlying the failure to achieve the CO_2 policy target for 2000 set in the second National Environmental Policy Plan – a reduction of 3% relative to 1990. (Instead of declining by 3% between 1990 and 2000 CO_2 emissions actually increased by more than 7%.) The CPB broke down CO_2 growth in the period 1990-1997 into the underlying component parts associated with different economic parameters. Actual developments in those parameters over the period were then compared with the assumptions that had been made when policies were developed at the beginning of the period. An ex ante assessment had supported the conclusion that average energy efficiency improvements of 1.7% per year in the years 1990-2000 would result in the desired CO_2 level in 2000, assuming:

- 1.9% per year economic growth
- 0.1% per year energy savings through changes in the structure of the economy
- 0.4% per year decline in carbon intensity (due to growth in natural gas use for combined heat and power and reduction in coal use for electricity generation)

The causes for the difference between the intended CO_2 reduction and that actually achieved were then allocated to the difference between these assumptions and the actual developments in the key parameters. This decomposition led to the following picture:

Table 1: Components of the CO_2 reduction shortfall, 1990-1997

parameter	assumption (average annual percentage change)	realisation (average annual percentage change)	difference between assumption (or target) and realisation in %-points
a) economic growth	+1.9	+2.5	0.6 (28%)
b) target for improvement in energy efficiency	-1.7	-1.5	0.2 (10%)
c) energy savings due to structure effect	-0.1	+0.3	0.4 (19%)
d) decline in carbon intensity	-0.4	-0.1	0.3 (15%)
e) unexplained	0.0	+0.6	0.6 (28%)
f) CO_2 target (a-b-c-d+e)	-0.3	+1.8	2.1 (100%)

Source: Netherlands Bureau for Economic Policy Analysis

This analysis would appear to suggest that failure to achieve the policy goal of improving energy efficiency accounted for only about 10% of the CO_2 reduction shortfall.[6] About 90% was due to the fact

[5] Netherlands Bureau for Economic Policy Analysis (CPB), *Naar een Efficiënter Milieubeleid*, November 2000, 175 pages.

[6] The CPB notes that conclusions about the success of the policy effort can only be drawn after correcting for the differences between the assumed and actual developments. Economic growth was actually 0.6%-points per year

that energy conservation policies were designed to achieve a given CO_2 effect within the context of an economic scenario that never materialized.

Contingency planning, robust assumptions and uncertainty analysis

Our poor track record with projecting economic developments over a long time period underscores the importance of contingency planning, making robust assumptions, and carrying out uncertainty analyses.

The NCPIP contains a package of reserve measures which serves as a safety net under the basic package of policies and measures, in case results fall short of expectations. The reserve measures are being prepared in such a way that they are ready and waiting "on the shelf" pending go/no-go decisions at evaluation moments in 2002 and 2005.

Budgetting decisions in the Dutch government are based on conservative estimates of economic growth, minimizing the chance of unforeseen deficits in the future. But climate change policy decisions proceed from higher estimates of economic growth in order to minimize the chance of overshooting emission targets. The principle is the same in both cases: build in a safety margin by proceeding from cautious estimates. However, the operational application of the principle differs in the two situations. Climate change policy decisions are based on higher estimates of prolonged economic growth than tax and spending decisions.

In the Netherlands, the largest uncertainties in estimates of future emissions have been found to be related to assumptions regarding the following economic parameters:

- sectoral growth or shrinkage in industry
- electricity prices in countries surrounding the Netherlands
- natural gas and oil prices
- competitive position of the Dutch refining sector
- industrial structure effects
- effectiveness of energy policies
- intensity of renewable energy policies in other countries and extent of tradeability
- autonomous growth in vehicle kilometers
- growth or shrinkage in greenhouse horticulture
- growth in new energy functions in the services sector (ICT)
- market power of Dutch electricity sector
- success of technological developments in off-shore wind energy.

Top-down plus bottom-up makes for more robust conclusions

One way to enhance the robustness of conclusions about emission reduction potential and costs is to carry out both bottom-up and top-down analyses. Results from the two approaches can serve to validate each other. Top-down analyses give aggregated results while bottom-up studies provide more insight into underlying relationships and determining factors. Many emission reduction measures do not lend themselves to being expressed as a coefficient in a top-down econometric model. Bottom-up

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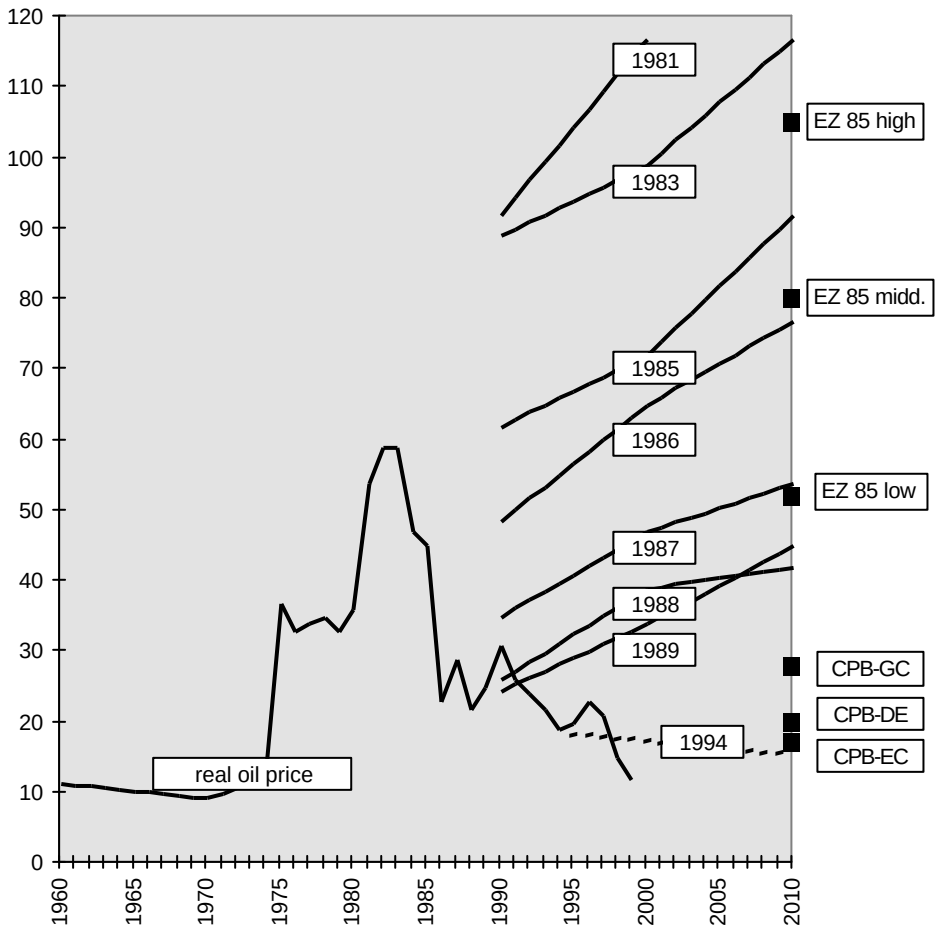
higher than assumed. There is a positive correlation between economic growth and improvements in energy efficiency, via the link with investment in new capital goods. Correcting for this effect lowers the improvement in efficiency by 0,2 %-points per year. This means that that if the economic growth had actually amounted to the 1.9% per year assumed, then the efficiency improvement would have amounted to only 1.3% per year, rather than the 1.5% noted in the table.

models can provide a useful tool for looking at sector-specific developments, new policy and new technology. The ICARUS data base (Information system on Conservation and Application of Resources Using a Sector Approach), developed by the University of Utrecht in the Netherlands, contains detailed information on the emission reduction potential and costs of existing, but not yet implemented, technical measures for improving energy efficiency. Availability of the ICARUS data base has facilitated many of the ex ante assessments of the effectiveness of new policies in the Netherlands. Investment in this kind of data base pays off in terms of informed decision-making.

Update, update, update

Our insights change all the time and with them our best guesses as to what the future will bring. This is illustrated by Figure 4, which shows the oil prices projected for 2010 in various studies conducted over the past 20 years on the right side of the figure. Those projections can be compared with the actual world oil prices between 1960 and 1999 shown on the left side. As the figure demonstrates, expectations have changed radically over time, due chiefly to new insights into the physical (non-) scarcity of fossil fuels.

Figure 4 : Actual and projected real oil prices, in 1997 USD/bbl



Our insights into other economic parameters are equally fluid. In the Netherlands we deal with this phenomonenon through an iterative process of ex ante analyses, which take into account our most recent

best guesses as to what future developments might be. New reference estimates of energy use and emissions in the year 2010 are made biannually, so that policy can be adjusted in time if it appears that a shortfall during the first budget period of the Kyoto Protocol might be likely. The most recent reference estimate is scheduled to be completed at the end of next month (November 2001). It will provide one of the main building blocks in the evaluation of climate policy which will be sent to Parliament early next year.

7. Ex Post Evaluations: What issues are we wrestling with?

There are two reasons why it is becoming increasingely important to check afterwards whether the intended results - in terms of emission reductions due to individual policies or measures - have been achieved. One reason is that the first budget period of the Kyoto Protocol is drawing nearer. If the results needed to meet the commitment are not being achieved, then we need to know that now. It takes several (on average 5 to 6) years before the impacts of new policies become visible in emissions. The second reason is that the "low hanging fruit" of climate change policy has been plucked. Further-reaching emission reductions will carry a price tag. It is important to ensure that emission reduction policies are not costing society more than is absolutely necessary. Some of the issues that arise in ex post evaluations include:

What is the baseline for an ex post evaluation?

Since emission reduction policies are directed at preventing something from happening, their effects can only be estimated relative to a fictional situation that never occurred. Ex post evaluations of how effective policies have been in practice must first establish a baseline, which needs to provide a plausible picture of what would have happened if a given policy had not been implemented. Sometimes establishing the baseline is straightforward, for example in the case of a process adjustment to reduce emissions from a given installation. The baseline is simply the emission that would have occurred had the process not been adjusted. This can usually be estimated based on past experience or engineering data. However, when the scale of the effect being striven after is not limited to a single installation or process but rather impinges on the whole energy economy, establishing such a baseline can be a tricky business.

Which developments were due to policy?

It is not always possible to separate the impacts of autonomous developments from the impacts of policies. Turnover in capital stock tends to result in energy efficiency improvements due simply to technological progress in the market. This is an autonomous development which would occur even in the absence of energy conservation policies. When we pursue energy conservation policies we are trying to accelerate or augment those improvements. Changes in energy efficiency can be calculated ex post, but it is often difficult to distinguish changes induced by policy from changes which would have occurred anyway. The issue of free riders is another example. Although tax breaks and subsidy programs appear to successfully encourage certain kinds of investments, it is likely that some of those investments would have been made even in the absence of the government policy. Recent studies in the Netherlands indicate that free riders may account for as much as 50 % of the investment reported under the Energy Investment Tax credit in the corporate income tax.

How can interrelated causal relationships be untangled?

Many different policy instruments are used to target the same source of emissions making it difficult to isolate the effects of the individual instruments in an ex post evaluation. Energy conservation in households is a case in point in the Netherlands. The regulatory energy tax, the energy premium for

purchases of efficient appliances and insulation, the Energy Performance Advice, energy efficiency standards in the building code, and various subsidy programs and forms of tax relief for district heating are all designed to converge on the same behaviorial or investment choices, often in the same segments of the market. This makes it very difficult to judge which programs and policies are having the greatest impact at the lowest cost. Sometimes such a judgement is impossible because the whole really *is* more than the sum of the parts. The price incentive provided by the regulatory energy tax is augmented by the availability of information about energy conservation options (via the Energy Performance Advice) and the energy premium. Without those secondary policy instruments it is unlikely that households would respond to the tax in the same way. In the Netherlands, the annual report to Parliament presents developments in emissions from different sectors, and provides a qualitative description of policies. This approach allows for an association to be drawn between the results achieved (in terms of emission levels rather than emission reductions) and the policy instruments deployed. This approach does not provide empirical support for conclusions about causality. However, it does make plausible that policies are playing a role in the dynamics of what is going on. The report over the year 2000 for the household sector is displayed in the following box.

Example of annual policy accounting: report on household sector over year 2000

CO_2 emissions due to natural gas use in households

CO_2 emissions in the household sector are defined as those which occur locally due to energy use for space heating and hot water. CO_2 emissions due to energy use for electric appliances and in vehicles is attributed to the energy and traffic sectors respectively. In recent years CO_2 emissions in the household sector have followed a path that lies somewhat beneath the Business as Usual scenario. Noteworthy is that household gas use and associated CO_2 emissions rose in 1999 and 2000 after years of steady decline. This increase cannot yet be explained. Given the uncertainty margins in the data, it would be premature to conclude that a trend has been breached. Electricity use in households rose by about 1% in 2000, to 21.5 TWH, according to preliminary data.

Government policy aimed at households consists of the following elements:

*energy costs are greatly affected by the regulatory energy tax, the rates of which have risen sharply over the past years;
*the Energy Performance Standard applies to new residential construction. The State Secretary for Housing will publish advice about tightening the standard following the summer recess;
*the Energy Performance Advice has been available for existing housing since 2000;
*labelling and standards have been introduced and negotiated agreements have been reached which aim to stimulate energy efficient appliances;
*the Energy Premium has been available since 2000.

Results achieved in the households sector include:

*a study of the effectiveness of the regulatory energy tax concludes that it has had a modest but demonstrable effect on household use of natural gas in the Netherlands. The tax's impact on electricity use has been significantly greater. Gas consumption decreased by an average of 35 m^3 per household per year over the period 1996-1999 due to the tax, compared to a situation with no tax. In the same period electricity use declined by 181 kWh per household per year due to the existence of the tax.
*subsidies were granted for about 13,000 solar water heaters in 2000, for a total amount of 3.1 million euro's including administrative costs;
*green declarations were issued for residential projects representing total equity of 123.8 million euro's during 2000;
*about 23,000 Energy Performance Advisories were carried out in 2000, while the target was 21,000;
*about 45.3 million euro's in Energy Premiums were paid out in 2000.

Assessment

CO_2 emissions from the sector fell between the Business as Usual scenario and the assessment line over the past two years. The impact of the EPA and the Energy Premiums should become visible during the coming years.

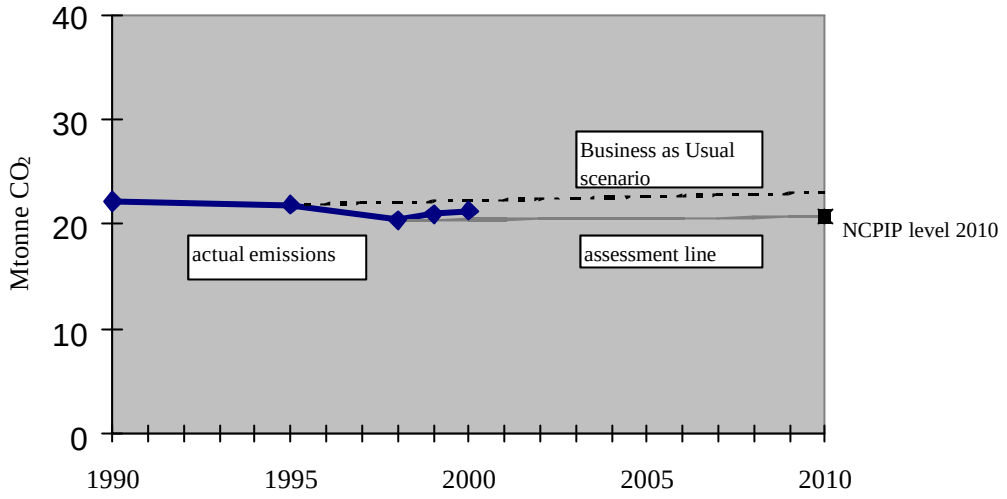


Figure: CO_2 developments in the household sector

Decomposition analysis is a valuable tool

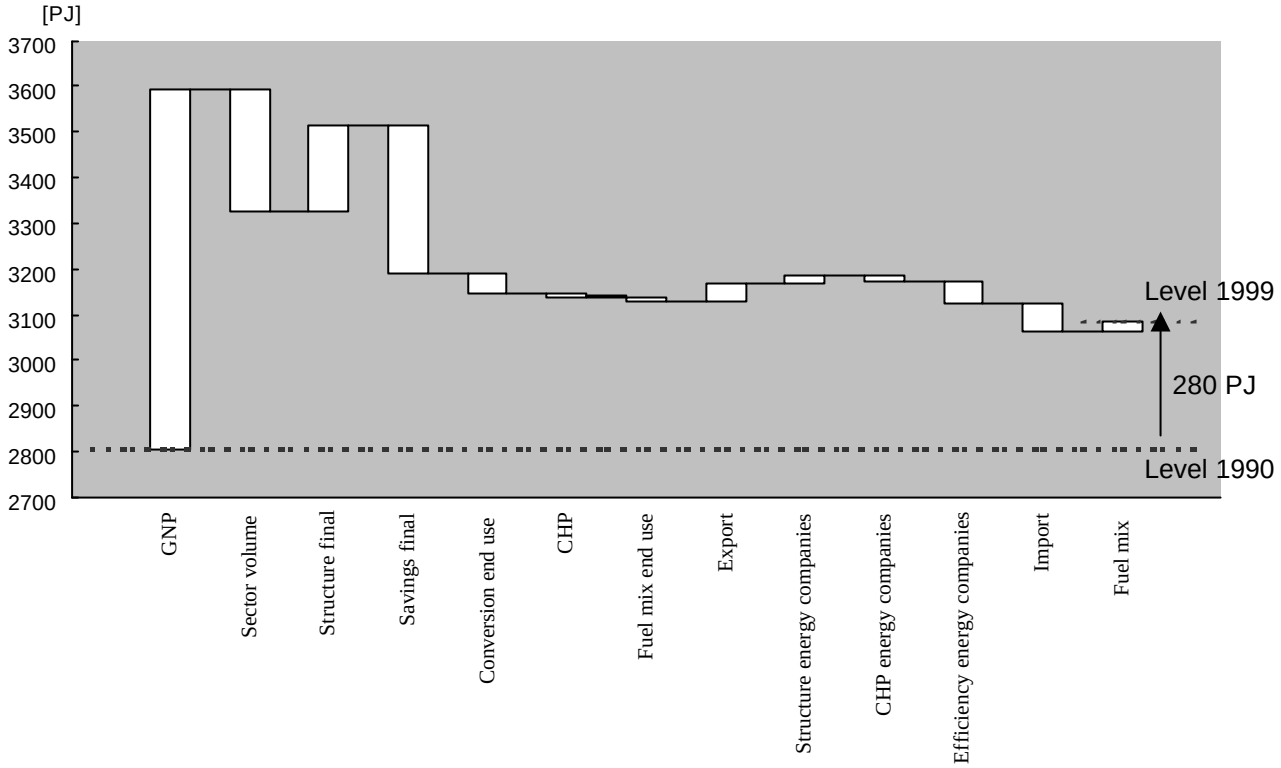
While decomposition analysis does not necessarily allow conclusions about which policy instruments are working well and which are not, it does provide insight into the factors at work. This can be illustrated by a decomposition analysis performed by the Energy Research Centre of the Netherlands (ECN).[7] The analysis sought to identify the role of various factors in explaining why energy consumption has not grown as rapidly as GNP over the past decade in the Netherlands. Attributing changes in energy consumption to different explanatory factors amounts to answering the question, "what would consumption have been if a given factor had had no influence?" The answer is provided one step at a time, by calculating various fictional levels of consumption. Starting with actual final energy consumption in 1990, a fictional level of consumption was calculated which reflected GNP growth in the period 1990-1999. The difference between this fictional level and the actual 1990 consumption level was attributed to growth in GNP. Then a new fictional level of consumption was calculated for a combination of GNP and the next explanatory factor in the analysis, volume effects. The difference between the fictional level from the previous step and that from this step was attributed to volume effects. An effect was attributed to each factor on a step by step basis, until the fictional, calculated level of consumption equalled actual consumption in 1999 and the whole difference had been explained. Figure 5 on the following page presents the results of the decomposition analysis.

8. Conclusions

Emission reduction policies appear to be bearing fruit in the Netherlands, although CO_2 reductions are falling short of expectations. Experience with ex ante assessment underscores the need for robust assumptions which minimize the likelihood of shortfalls and for contingency planning which allows for timely responses. Ex post evaluations need to be refined to provide more insight into why some policies have worked better than others in the past.

[7] Energy Research Centre of the Netherlands (ECN), Energie Verslag Nederland 2000, 2001, 128 pages.

Figure 5 : Components of decoupling between energy consumption and economic growth, 1990-1999



Source: Energy Research Centre of the Netherlands