# Monitoring based on the logical framework approach: the energy use of dwellings in the Netherlands

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## Abstract

The Dutch government wants to achieve its energy policy goals by increasing the use of energy saving techniques like insulation, high-efficiency heating-systems and also by increasing the gas price. Several policy instruments have been implemented and it is necessary to monitor their effects. Gas consumption, however, is also affected by other factors, like the number of dwellings and the age of inhabitants and this complicates monitoring. The logical framework approach promised to be a useful tool in setting up a consistent and practical monitoring report of energy use of dwellings in the Netherlands. Central question of this paper is: Can the Logical Framework Approach (LFA) be used to establish an effective plan for monitoring the effects of energy policies on the consumption of gas by dwellings? Related questions were: Which effects should be measured, which indicators should be used for the effects, how are the indicators related, and if the target values are not met, what are the reasons for the divergence? The LFA was applied, where the overall policy objectives, the project purpose, results, activities, assumptions and their causal relationships were systematically analysed. The study demonstrates that the LFA can be used to establish an effective plan for monitoring the effects of energy policies. Furthermore, our experience leads us to believe that the method can be widely used to set up other policy monitoring plans. Specifically, information should be gathered related to the target values and the use of policy instruments. Also information on an intermediate level is needed to describe the results of the policy instruments and other uncontrolled factors.

## Introduction

In line with the Kyoto target for carbon dioxide emissions the Dutch government set target values for carbon dioxide emitted from buildings for the year 2010. These target values specify maximum carbon dioxide emissions (Mt $CO_2$). To ensure that these target values will be met, several policy instruments have been developed, and the government needs to monitor the results of these policies. And, if necessary, additional sector-specific policy measures will be introduced to meet the carbon dioxide target.

Although the target for buildings refers solely to direct carbon dioxide emissions, in practice, this means that only the emissions resulting from natural gas consumption are included. In the Netherlands other fuels can be neglected. Indirect emissions resulting from electricity consumption are ascribed to the power sector, which also has to meet its allocated target. At the moment, this approach is still applicable, since fuel substitution (e.g. use of electric heat pumps instead of condensing boilers) is minimal for the residential sector. For that reason, in this study we focused on monitoring the effects of policies on gas consumption in dwellings.

We believe that the implementation of government policy should be based on a programme theory that describes how the policies relate to their purposes (Rossi et al., 1999). A programme theory can be constructed using the logical framework approach (LFA), where the overall policy objectives, the project purpose, results, activities, assumptions and their causal relationships can be systematically addressed. The LFA is been used for various types of projects by the Worldbank and the EU[1].

The central question of this study is: Can the LFA be used to establish an effective plan for monitoring the effects of energy policies on the consumption of gas by dwellings? Related questions are:

- Which effects should be measured, should information be acquired about the target values, the policy instruments or something in between?
- Which indicators should be used for the effects?
- How are the indicators related?
- If the target values are not met, what are the reasons for the divergence?

We used the LFA as the basis for monitoring the policy process and performance. We first studied the various policy instruments related to saving energy in the residential sector (Section 2). We applied LFA to develop a plan to monitor the effects of these instruments in the Netherlands with respect to dwellings (Section 3). We then used existing data to fill in the different levels of LFA (Sections 4 and 5). Specifically, we focused on measurements of the insulation rates for glass, roof, wall and floor, which are the focus of Dutch energy policy. Conclusions are presented in Section 8.

## Energy policy in the Netherlands[2]

In the Netherlands, 'target values' for carbon dioxide emission per sector are being developed. These target values specify maximum carbon dioxide emissions (Mt $CO_2$) for each sector in the year 2010. Just as with all sectors, the building sector, is responsible for reaching its target. If necessary, additional sector-specific policy measures will be introduced to meet the carbon dioxide target.

The target for buildings refers solely to direct carbon dioxide emissions. In practice, this means that only emissions resulting from natural gas consumption are included, as other fuels can be neglected in the Netherlands. Indirect emissions resulting from electricity consumption are ascribed to the power sector, which also has to meet its allocated target. At the moment, this approach is still applicable, since fuel substitution (e.g. use of electric heat pumps instead of condensing boilers) is minimal for the residential sector.

To meet the target values in the residential sector a set of instruments have been developed:

- Energy Performance Standard (EPN), introduced in 1995. This standard enables the calculation of the integral energy performance of a new dwelling and consists of a standardized method for the calculation of an energy performance coefficient (EPC) by a reference figure related to the size of the dwelling. Before the EPN, minimum thermal insulation values for the shell of a dwelling were used. The integrated approach takes into account the total energy demand of a building as determined not only by the insulation values of the various parts of the building shell, but also by their surfaces, and by heating, air-conditioning and hot water equipment. The EPN is mandatory part of the Dutch Building Code.
- The Regulatory Energy Tariff (REB), introduced in 1996, aimed to lower the overall electricity and gas consumption of households by increasing the price of electricity and gas.
- Energy Premium Regulation (EPR). The EPR subsidizes housing insulation, very efficient central heating boilers, solar boilers and PV systems. The EPR is financed from the revenues of the REB tax. In 2003 public funding of the EPR was halted.
- Energy Performance Advice (EPA) for existing dwellings, introduced in 2000. Energy-saving measures in existing dwellings are mapped through EPAs. It is the intention that the advice given by EPA then leads to the implementation of measures. The EPA advice and the implementation of advised measures are voluntary, but both are supported by EPR subsidies. The EPA is comparable with, though a simplification of, the EPN.
- BANS. The Climate Covenant in the framework of the Administrative Agreement New Style (BANS) between the government and local authorities involves the efforts of local authorities to support government climate policy. Within the theme of dwelling-construction, three effort levels are distinguished: 'active', 'trend setting' and 'innovative'.
- Energy Performance on Location (EPL). The EPL aims to increase the energy performance of newly built districts by assessing the energy demand of the whole housing location including energy facilities.
- EU Energy Performance Directive for Buildings. In 2006 this Directive (EU, 2002) will establish energy requirements for new dwellings and dwellings that are to be renovated and the availability of energy certificates with respect to existing buildings that change owners. EPC values for new housing in the Netherlands already meet the first prescribed requirement.

## Logical framework approach

To set up a plan for monitor the effects of governmental policies, we applied the logical framework approach (LFA). The logical framework approach is an integrated and systematic way of thinking about a project's objectives at different levels[3]. In our case, 'project' means 'all government activities related to reducing carbon dioxide emissions in the residential sector'. We analysed the levels of this project's objectives as follows:

- Overall Objectives: why is the Dutch energy policy for the built environment be important for the society/ at na-

1. The LFA method does not only consist of the log frame matrix, but also consists of stakeholder analysis, problem analysis and building a goals-tree. A participatory communication process s developed to prepare a concrete and realistic plan. See for more information on LFA http://www.pcm-group.com
2. See Jeeninga and Kets (2004)
3. The log frame approach is a useful tool to get a scientific foundation for government policy. The relations between results/assumptions and the project purpose can be seen as a multiple regression model, which is the basis of econometric policy theory. (Mierlo, 2002)

tional level? What are the expected benefits to the society?

- Project Purpose: why this project is important for the beneficiaries. It should describe what positive change the beneficiaries will initiate as a result of the project.
- Results: What services will the project provide to the beneficiaries to enable them to achieve the project purpose?
- Activities: What are the main activities to be carried out to achieve each result?
- Important assumptions: What are the external conditions that are necessary to be present or are to be made available to achieve the results and the project purpose, but which are not under the direct control of the project?

In Figure 1 the levels of objectives and the relations between the levels are presented. The overall objective is reduction of carbon dioxide emissions (Mt $CO_2$) in 2010. To reach this objective a behavioural change of building owners and users is necessary—they have to reduce the energy consumption—this is the project purpose. But the owners and users are also the beneficiaries—reduction of energy use will satisfy them because of lower costs and increased value of their dwellings[4].

To achieve the project purpose, activities (policy instruments) are undertaken to increase investment in energy saving techniques and to improve the beneficiaries' energy saving behaviour. But not only policy instruments influence the results and project purpose. Also other factors (the assumptions) can play an influential role.

Monitoring the effects of energy policy concentrates on the project purpose, results, activities and related assumptions (the area in Figure 1 with the dotted lines). After building the log frame, indicators for the crucial variables at the different levels are developed. The next step is to measure these indicators using available resources or when additional data gathering is necessary using data collection techniques, which are extensively described in literature.

In the previous section, we described the energy policy in the Netherlands is described that focuses on overall objectives and the policy instruments. In the log frame, attention is also given to external factors (assumptions). The advantage of paying attention to the assumptions is that if the overall objective is not met, the reason can be:

- the policy instrument does not have the expected effect, or
- factors which are not under control of the energy policy.

For making a correct evaluation the assumptions should therefore also be monitored.

Comparing the log frame matrix and the previous section it is striking that in the log frame approach two additional levels are introduced: project purpose and results. These levels are introduced because the policy instruments do not have a direct effect on the $CO_2$ emission (the overall objective). The policy instruments leads to services obtained by the beneficiaries of the project: the beneficiaries are able to invest in energy saving techniques and to improve their energy saving behaviour. These results lead together with the assumptions on volume change and structural changes to the project purpose. The project purpose is the focal point of the project and contributes to the overall objectives.

## Expected versus projected gas consumption

The overall objective is the reduction of carbon dioxide (Fig. 1). The expected emissions of carbon dioxide in the residential sector (the overall objective) between 1995 and 2010 was determined by Energy Consulting Network

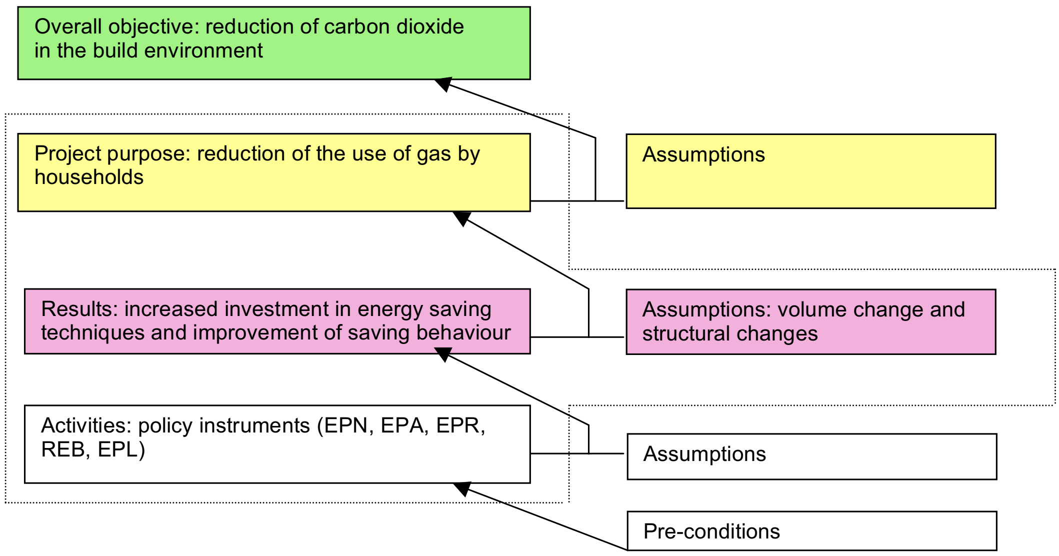


***Figure 1.*** *Log frame matrix and the energy policy of dwellings.*

4. Separate log frames can be made for landlords and tenants, because of ease of presentation this distinction is not made in this paper.

**Table 1. Total gas consumption of households; ECN Reference Projection and actual values (in mln. $m^3$, between brackets indices; 1995 = 100)**

| | ECN Reference Projection Projection values | | Actual values | | Difference between actual and projection value |
|---|---|---|---|---|---|
| 1995 | 12 291 | (100) | 12 291 | (100) | 0 |
| 2000 | 11 912 | (96.9) | 12 227 | (99.5) | 315 |
| 2001 | 11 804* | (96.0) | 11 908 | (96.9) | 104 |
| 2002 | 11 697* | (95.2) | 11 788 | (95.9) | 91 |
| 2005 | 11 374 | (92.5) | | | |
| 2010 | 10 995 | (89.5) | | | |

*Linear interpolation
Source: ECN, 2003

(ECN) in a Reference Projection (Boonekamp et al., 2004). They used a model called 'Simulation and Analysis of Virtual energy use in Energy scenarios' (SAVE-Households) for emission calculations. These emissions are based on the gas consumption in the household sector (the project purpose in Figure 1).

From these expected emissions of carbon dioxide presented by ECN (2003), we recalculated the projected gas consumption and then compared it with actual consumption (Table 1).

According to the Reference Projection, gas consumption of households should decrease by 11% in the period 1995-2010, about 0.75% per year. The actual gas consumption fluctuates, although it is corrected for temperature differences between the years. The actual decrease in 2000 was only 0.5% and not the projected 3%[5]. In 2001 the actual decrease was 3%, while the projected decrease was 4%. In 2002 the actual decrease was 4% while the projected decrease was 5%. The differences between projected values and the actual values are becoming smaller implying that the policy goals for 2010 are achievable.

## Results and discussion

The results according to Figure 1 are the savings: through increased investment in energy saving techniques and

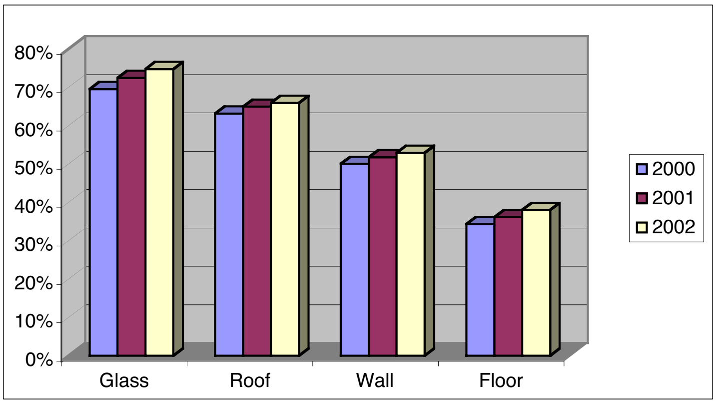


***Figure 2.*** *Insulation rates of glass, roof, wall and floor for the years 2000, 2001 and 2002.*

through increased energy-saving behaviour. The results are, however, only partly caused by policy instruments. Other factors related to volume change and structural changes, lie beyond the influence of energy policies.

### SAVINGS

#### Energy saving insulation

The investments in energy saving techniques are related to insulation of glass, roof, wall and floor, and space heating and hot water apparatus.

The insulation rate of Dutch dwellings varied in 2002 from 38% for floor to 75% for glass. The insulation rate for roof was 66% and for wall was 53%. The change in insulation presented in Figure 2 can be attributed to two factors[6]:

- Change in the number of dwellings (new buildings are fully insulated and old buildings without insulation are demolished);
- A change in the existing dwellings (share of dwellings insulated per year).

Different policy instruments influence these two factors. For that reason, we distinguished between these two factors and present the data Table 2 for the periods 1995-2000 and 2001-2002.

The annual change in the years 2001 and 2002 differed among the building parts; the high change for glass is remarkable. Despite the low number of dwellings build in the Netherlands in this period, the change due to a change in the number of dwellings was substantial. The average annual change is comparable between the two periods. The influence of the change in existing dwellings grows.

The space heating system changes from conventional to high efficient ones, these are 15% more efficient. The penetration rate of high efficient heating systems in dwellings with a space heating system grows from 40% in 2000 to 45% in 2002. The efficient space heating systems are more and more combined with the hot water system.

An increase in insulation and high efficient heating systems leads to a decrease in the gas consumption (calculated using figures of Alsema et al., 2001).

5. The values of 2001 and 2002 are obtained by linear interpolation of the projected figures of 2000 and 2005.
6. The insulation rates are calculated combining different data sources, for a description of the method used, see the appendix.

**Table 2. Average annual change in insulation rates in percent points.**

| | Glass | | Roof | | Wall | | Floor | |
|---|---|---|---|---|---|---|---|---|
| *Period 1995-2000* | | | | | | | | |
| Change due to a change in the number of dwellings (new buildings are fully insulated and old buildings without insulation are demolished) | 0.6 | (23%) | 0.7 | (28%) | 0.8 | (44%) | 1.0 | (48%) |
| Change in existing dwellings (share of dwellings insulated per year) | 1.9 | (77%) | 1.7 | (72%) | 1.0 | (56%) | 1.1 | (52%) |
| Total | 2.4 | | 2.4 | | 1.8 | | 2.0 | |
| *Period 2000-2002* | | | | | | | | |
| Change due to a change in the number of dwellings (new buildings are all fully insulated and old buildings without insulation are demolished) | 0.3 | (11%) | 0.4 | (27%) | 0.6 | (35%) | 0.7 | (35%) |
| Change in existing dwellings (share of dwellings insulated per year) | 2.7 | (89%) | 1.2 | (73%) | 1.0 | (65%) | 1.4 | (65%) |
| Total | 3.1 | | 1.6 | | 1.6 | | 2.1 | |

Source: SenterNovem 2003

### Price of gas

The price of gas is influenced by the Regulatory Energy Tariff (REB). Beside the REB there are also other taxes like the gross value added. There is a substantial rise in the REB, see Figure 3. The effect of a price increase on the gas consumption is small, the price elasticity is –0.1.

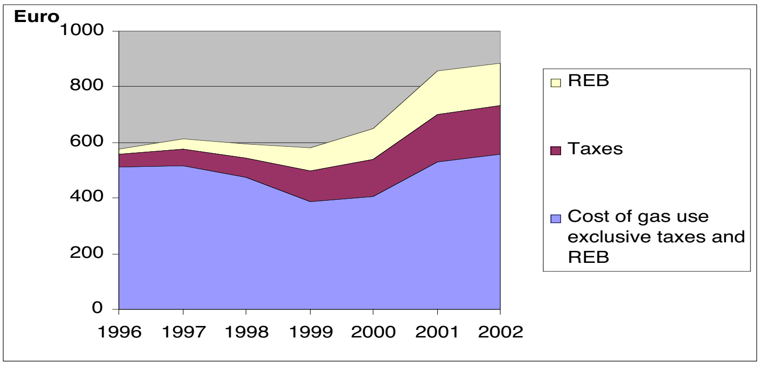


***Figure 3.*** *Average cost per dwelling for the gas consumption, taxes and REB.*

## VOLUME CHANGE

The change in the number of dwellings in the Netherlands is described in Table 3. The number of dwellings still increases, but the annual change drops from 1.36% in 1995 to 0.81 % in 2002. Every new dwelling leads to an increased gas consumption, but new dwellings are more energy efficient than old dwellings.

## STRUCTURAL CHANGES

### Occupation, age, size, type

The number of persons per dwelling decreased from 2.49 in 1995 to 2.4 in 2001. This change in occupation rate leads to an decrease in the gas consumption per dwelling. One additional member to the household leads to an increase in the gas consumption by 91 $m^3$ per dwelling (CE, 2003).

The average age of people in the Netherlands increases every year. Especially the group above 65 years increases. Because this group likes to have a higher temperature in their dwellings than younger people, an increase of the average age by 1 year leads to an additional gas consumption by 6.6 $m^3$ per year per dwelling (CE, 2003).

The size of new dwellings increases from 414 $m^3$ in 1995 to 488 $m^3$ in 2000 (DGW, 2003). According to the CE study (2003) one extra $m^2$ of a dwelling leads to an increase in the gas use by 11 $m^3$.

The dwelling type hardly changes between 1995 and 2000. There is a slight increase in detached dwellings and a decrease in terraced dwellings.

**Table 3. The change in the number of dwellings in the Netherlands.**

| Year | Stock begin | Increase | | Withdrawings | Stock end | Change (%) |
|---|---|---|---|---|---|---|
| | | new dwellings | Other | | | |
| 1995 | 6 191 922 | 93 836 | 4 923 | 13 688 | 6 276 045 | 1.36 |
| 1996 | 6 276 045 | 88 934 | 5 648 | 11 513 | 6 357 569 | 1.30 |
| 1997 | 6 357 569 | 92 315 | 4 330 | 12 527 | 6 440 511 | 1.30 |
| 1998 | 6 440 511 | 90 516 | 4 961 | 13 098 | 6 522 362 | 1.27 |
| 1999 | 6 522 362 | 78 625 | 3 951 | 14 354 | 6 589 662 | 1.03 |
| 2000 | 6 589 662 | 70 650 | 4 119 | 13 528 | 6 650 911 | 0.93 |
| 2001 | 6 650 911 | 72 958 | 4 654 | 15 555 | 6 709 732 | 0.88 |
| 2002 | 6 709 732 | 66 704 | 4 575 | 16 410 | 6 764 286 | 0.81 |

Source: DGW, 2003; CBS, 2003

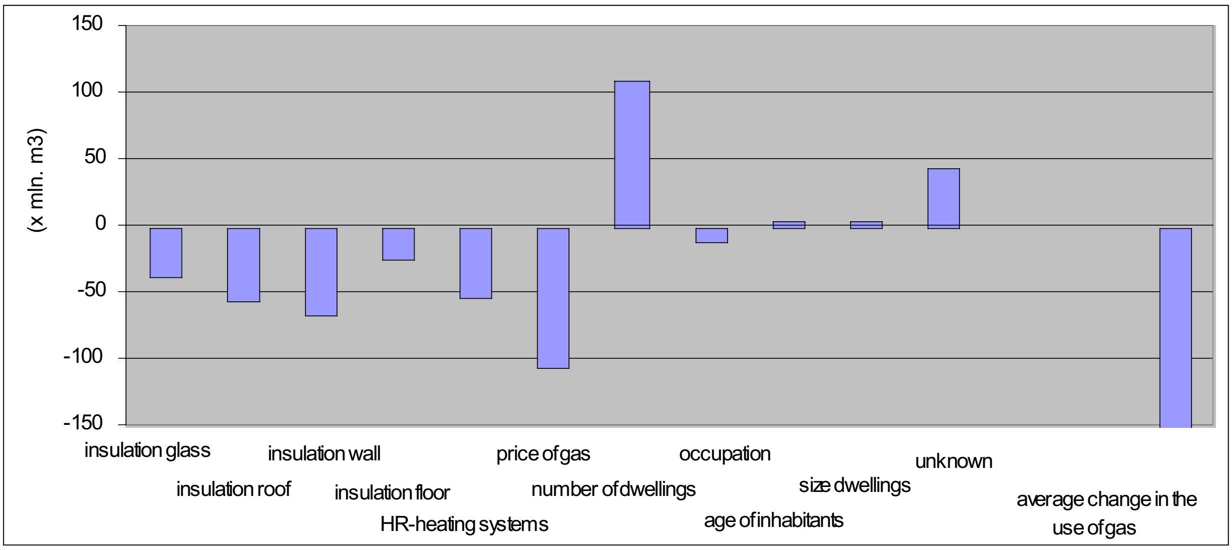


***Figure 4.*** *The average change in the gas consumption in 2001 and 2002 explained by savings, volume and structural effects.*

## Relation between results/assumptions and project purpose

According to Figure 1 the development in the gas consumption is attributed to the savings (the results in the log frame matrix) and volume change and structural changes (the assumptions in the log frame matrix).

The average change in gas consumption in 2001 and 2002 is equal to -200 mln m$^3$ in the Netherlands. The relations between the results/assumptions and the project purpose are investigated, the findings are presented in Figure 4. The effects of the various influencing factors are based on a literature survey with respect to (mainly) elasticities, this information is already described.

The average decrease in the gas consumption in 2001 and 2002 is mainly caused by the increasing gas prices and the growing insulation rates. The price- and savings-effect is partly reduced by the volume effect: the number of dwellings increases. Of course we cannot completely explain the change in the gas consumption. This is depicted by the column 'unknown' in Figure 4.

## Effects of the activities

The activities undertaken by the Dutch government to achieve the results are already described in a previous section. In this section the effects of these activities are described:

- Regulating Energy Tax (REB): as a result, the gas price increases and this effect is presented in Figure 4.
- Energy Performance Standard (EPN): in all new dwellings insulation is applied, but the EPC standard has a positive effect on the quality of insulation used. Dwellings with a lower EPC standard use less gas, although the effect of a further reduction of the standard decreases (SenterNovem 2004a).
- Energy Premium Regulation (EPR): in about 17% of the dwellings applying insulation in 2000 and 2001 used EPR (SenterNovem, 2003). According to Joosen et al. (2005) the impact of the EPR on investing in insulation is rather limited, because the percentage of free riders for the subsidised standard forms of insulation is very high.
- Energy Performance Advice (EPA): The number of EPAs made in 2000 and 2001 is about 8% of the dwellings applying insulation in 2000 and 2001 (SenterNovem, 2003). According to Joosen et al. (2005) EPA leads to a small additional investment in insulation.
- BANS : In current construction, there are certain preconditions for sustainability and the number of EPA consults. For current dwelling-construction Menkveld et al (2002) does not assume an additional effect, given the developments of the EPA approach, the obligatory EU certificates and the EPR.

## Conclusions

In this study we demonstrate that the LFA can be used to establish an effective plan for monitoring the effects of energy policies on the consumption of gas in dwellings. Furthermore, our experience leads us to believe that the method can be widely used to set up other policy monitoring plans.

Based on our study, information should be gathered related to the target values (the actual gas consumption) and the use of policy instruments, and also on an intermediate level. This intermediate level describes the results of the policy instruments (insulation rates) and other factors (number of new dwellings, price of gas) which are necessary to achieve the target values.

The indicators of the logical framework were monitored for the years 2000 till 2002. There was a steady increase in insulation rates, the number of new dwellings decreased and the price of gas rose considerably. These are the main factors that explain the decrease in gas consumption in 2001 and 2002. We conclude that the policy objectives are achievable, as long as the number of new dwellings remains small. The influence of the policy instruments is therefore, appropriate. This analysis can be used for policy advice.

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## Appendix: Combining data sources for the measurement of insulation rates

The insulation rates of the dwellings in the Netherlands are measured in 1995 and 2000 by the Qualitative Dwelling Registration (KWR) done by VROM. This research is based on a sample of 15 000 dwellings, which are in detail inspected on the insulation of a dwelling with respect to glass, roof, floor and wall. This inspection is done by certificated inspectors. These figures come available with a time lag of two years. For monitoring of governmental policy the frequency of five years and a two year time lag in availability of the data is too long.

EnergieNed gathers also data of insulation rates. Yearly a panel of 3 000 households are called by phone to get information on energy use and investments in insulation. The panel is called HOME. The figures on insulation are not as reliable as the figures of the KWR, but the data on energy use gathered by HOME are used by the CBS.

To come to a consistent set of figures on insulation rates the two data sources are combined. Basis are the insulation rates of the KWR-2000. The annual changes are calculated using the households, which are in 2000 and 2001 in the HOME panel. It is reasonable to assume that these households know if they have invested in insulation between 2000 and 2001. The answers given by phone on these investments are far more reliable than asking households if insulation is available in the dwelling.

Data at a dwelling level cannot be used, because the dwellings in KWR differ from the dwellings in HOME. To use as much information as is possible in the data we distinguish 40 dwelling types, related to building year (till 1945, 1945-1966, 1966-1976, 1976 and later), dwelling type (5 types) and ownership (owner or rented).

The method to calculate the yearly insulation rate (which is done for the 40 dwelling types and 4 types of insulation) consists of 5 steps:

1. Start with the insulation rate of KWR 2000 (if calculating the insulation rate of 2001)
2. The number of insulated dwellings is corrected for changes in the number of dwellings (except for new dwellings), assuming that the insulation rates of these dwellings are the same as the other dwellings of the same type.
3. The number of insulated dwellings is increased by the number of new dwellings, because these new dwellings are all insulated.
4. The insulation rates are changed by the annual changes calculated using the HOME panel.
5. Removals are not taken into account appropriately in the HOME panel. Removals apply more often insulation than not-removals, according to the Dwelling Needs Research (WBO). A correction factor is used to take this difference into account.

The most important steps are step 3 and 4. We illustrate these steps for the change in floor insulation between 2000-2001 and the rented terraced building type. Step 3 (new dwellings) is illustrated for dwelling type with building year 1976 and later.

The insulation rate for the dwellings with building year 1976 and later according to KWR is equal to 0.824. For all dwellings the average insulation rate is 0.267. The related number of dwellings are 229 426 and 832 515. The number of insulated dwellings is on the upper right hand corner of Figure A.1. For dwellings with building year 1976 or later is the number of insulated dwellings equal to 189 131 (= 0.824*229 426) and for all dwellings this is equal to 222 135 (0.267*832 516).

According to CBS the number of new dwellings in 2001 for the rented terraced building type is equal to 4 810 (these are all with building year 1976 and later). This is presented in the middle part of Figure A.1.

The number of dwellings and insulated dwellings in the lower part of Figure A.1 is the sum of the two upper parts. Using these numbers the insulation rates in the lower left corner of Figure A.1 are calculated. The insulation rates for

| | | *insulation rate* | number of dwellings | *number of insulated dwellings* |
|---|---|---|---|---|
| start | building year 1976 > | *0,824* | 229426 | *189131* |
| | all dwellings | *0,267* | 832515 | *222135* |
| change | building year 1976 > | *1,000* | 4810 | *4810* |
| | all dwellings | *1,000* | 4810 | *4810* |
| result | building year 1976 > | *0,828* | 234236 | *193941* |
| | all dwellings | *0,271* | 837325 | *226945* |

***Figure A.1*** *Schematic presentation of step 3.*

| | | *insulation rate* | number of dwellings | *number of insulated dwellings* | number of not-insulated dwellings |
|---|---|---|---|---|---|
| start | building year 1966-1976 | *0,055* | 200762 | *11098* | 189664 |
| | all dwellings | *0,271* | 837325 | *226945* | |
| change | building year 1966-1976 | | | | -2831 |
| | all dwellings | | | | |
| result | building year 1966-1976 | *0,069* | 200762 | *13929* | 186833 |
| | all dwellings | *0,274* | 837325 | *229776* | |

***Figure A.2.*** *Schematic presentation of step 4.*

dwellings with building year after 1976 and all dwellings are increased as a result of new dwellings.

Step 4 is illustrated for dwellings with building year 1966-1976 and is presented in Figure A.2. An extra column is added, because the changes in HOME are related to not-insulated dwellings.

Floor insulation is applied in 2831 dwellings of the rented terraced building type in 2000-2001, according to the information of the HOME panel. Using this number and the total number of dwellings the number of insulated dwellings is calculated in the lower part of Figure A.2. This is done for every building type year, resulting in the total of all dwellings. Finally the insulation rates are calculated in the lower left part of Figure A.2.

The method described is validated for the period 1995-2000, because for 1995 and 2000 insulation rates of KWR are available. The method turns out to give a good description over this period. Also confindence intervals are calculated for the period 2000-2002. The yearly decrease in reliability is rather small. For an extensive description of this investigation, see SenterNovem (2004b).