Environmental protection expenditures of households home improvement

Final report

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1 Introduction

This report deals with the environmental protection expenditures of households in the Netherlands related to home improvement. According to the EPE continuation program granted by Eurostat, Statistics Netherlands examines missing sectors that are relevant for understanding environmental policy, spending and revenues. Although the sector 'Households' is not a sector according to the 'Standaard Bedrijfsindeling' (SBI) (NACE) insight in environmental expenditures related to home improvement of households will improve the environmental expenditures statistics and increases the insight in environmental protection measures taken in the Netherlands. The year of analysis is 2009.

The goal is to set up an estimation method for the environmental costs and investments Dutch households make for home improvement regarding to energy efficiency and the environment. According to the EU – Directive 'on the energy performance of buildings' the built environment plays an important role in the reduction of greenhouse gas emissions by reducing energy consumption and using renewable sources (EU, 2010). The Energy Performance of Buildings Directive (EPBD) is a European directive implemented in 2003. The EPBD describes standard methodology to calculate the energy performance of (existing) buildings and sets the standard for newly built buildings. To meet the EPDB-standard on a national level the 'Energieprestatienorm van Gebouwen' (EPG) (Energy Performance standard of Buildings) is developed in the Netherlands which is applied in July 2012.

In 2009 households are responsible for 425 Peta Joule (13% of total 3266 PJ) energy consumption in the Netherlands. Households consume 42% of the energy consumption in the built environment, mostly for heating, warm water and electricity (CBS-1, 2011). Halving the energy consumption of households including heating by 2030 (compared with 1990) will mean a tremendous effort of building owners to improve their buildings (BZK, 2011, p.8). Because of the potential of the built environment to save energy it is an important point of interest for the government, building owners and the market. Newly built dwellings in the year 2020 should for example be self-sufficient *'energieneutraal'* in their use of energy. Not only energy saving also more local (sustainable) power generation is part of the energy transition within the built environment.

In this report not only the environmental related improvements of the dwelling stock are examined. By looking at ownership relations also the responsibility households have are appointed. In chapter 2 three main ownership categories are distinguished: 1/ owner-occupiers, 2/ social housing corporations and 3/ private rental sector. Stimulation measures of the government are used for all three categories and given in chapter 3 over the period 2009-2013.
In chapter 4 the Energy Label Database (ELD) of AgentschapNL is examined. Because about 25% of all dwellings in the Netherlands are included in the ELD (to 2010) the ELD provides good insight in the energetic quality of the dwelling stock (AgNL-1, 2010). For determining environmental protection expenditures (EPE) in chapter 5 surveys from TNS-Nipo (housing corporations) and Intomart GfK (private owners) commissioned by AgentschapNL are used (AgNL-3, 2010). The numbers of measures with respect to ownership relations are combined with specific research from Statistics Netherlands about the dwelling stock and the subject of renewable energy.

Chapter 6, in the conclusion the results of chapter 3 (subsidies) and 5 (EPE) are given. The burden (EPE – subsidies) for households stemming from home improvement measures is given together with recommendations for further research and some final remarks.

2 *Responsibility home improvement*

First of all it is important to determine which households are responsible for home improvement measures. Ownership is important in the case of ascribing environmental protection expenditures. The number of dwellings is relevant because in research used for this report not the number of households but the number of addresses and dwellings is relevant. Three statistics are used for ownership, dwelling stock and households. The difference between figures about ownership and dwelling stock is depending on the used sources. The WoON-research and *'Gemeentelijke Basis Administratie'* (GBA) 'Basic Administration Municipalities' are the most important registrations. Table 2.1 shows the number of private and rental dwellings in relation to the dwelling stock and number of households in the Netherlands.

Table 2.1: Number of dwellings in the dwelling stock according to ownership and number of households in the Netherlands (year 2000 and 2009)

	Ownership dwelling category	Number of dwellings [1]			
		2000	%	2009	%
1	Private property (owner occupier)	3.394.000	51,5%	4.120.400	58,0%
2	Social rental housing	2.275.000	34,5%	2.359.300	33,2%
3	Private rental housing	475.000	7,2%	414.900	5,8%
4	Undefined rental housing	361.000	5,5%	101.800	1,4%
5	Subtotal rental property (2+3+4)	3.111.000	47,2%	2.876.000	40,5%
6	**Total ownership dwellings (1+5) [1]**	**6.505.000**	**98,7%**	**6.996.400**	**98,5%**
7	**Dwelling stock (1st of january) [2]**	**6.589.662**	**100,0%**	**7.104.518**	**100,0%**
8	**Households (1st of january) [3]**	**6.801.008**	**103,2%**	**7.312.579**	**102,9%**

Source: Statistics Netherlands

[1] Ownership - survey WoON-onderzoek – Statline (CBS-2, 2012)
[2] Dwelling stock - GBA/ survey municipalities – Statline (CBS-3, 2012)
[3] Households - GBA/ survey labor force – Statline (CBS-4, 2012)

The responsibility for home improvement is mainly in the hands of owner-occupiers (58%) (private owned dwellings), housing corporations (33%) (rental housing) and owners that use their property for private renting (6%). The number of households is higher then the number of dwellings. A household is defined as one or more persons living under the same roof and providing in their own daily needs. The dwelling stock is based on the number of dwellings with a post address. The number of households over dwellings is 208.061 in 2009. This is explained for example by students and elderly that are counted as household living in building blocks with the same address. In this research the number of addresses or dwellings in the dwelling stock prevails over households. The group of students and elderly is not accountable for home improvement measures related to the EPE.

Public and private dwelling owners share the responsibility to improve their dwellings in the dwelling stock. From almost 7 mln (98% of 7,1 mln) dwellings the ownership regarding to private or public and rental housing is known. Households regarding to private property (owner occupiers) are directly involved in making costs for home improvement measures. Households related to private and social renting are not responsible for home improvement measures at first, the owners are. The majority of dwellings 4,1 mln (58% of 7,1 mln dwellings) is in private hands (owner occupier), 2,9 mln (40%) is rental housing and could be ascribed to NACE – 68.

3 *Energy saving plan built environment*

The government acknowledges the importance of improving the energetic quality of existing buildings. According to the *'Plan van Aanpak Energiebesparing Gebouwde Omgeving'* (EGO) (Energy Saving Plan Built Environment) the built environment is good for 30% of total energy consumption in the Netherlands (BZK, 2011). In recent years the government stimulated home and building owners with several programmes. Most important is the improvement of the energetic quality of existing buildings. Home improving measures are supported with subsidies and fiscal arrangements also the environmental awareness increased with the introduction of the energy label and energy performance advice.

The Ministry of the Interior and Kingdom Relations (BZK) published the plan 'Energy saving plan built environment' in 2011. In this plan the strategy to improve the energetic quality of buildings (existing and new) is laid down. In 2009 the Ministry of Housing, Spatial Planning and the Environment (VROM) supported initiatives to improve the dwelling stock. The main reason for supporting these initiatives is the European climate change purpose of 20% CO_2 - reduction in 2020 based on 1990 emission levels. With subsidies on energy saving measures in the built environment not only CO_2 – reduction is involved, also the standard of living is improved and the (social) housing costs can be kept within limits (BZK, 2011).

Stimulation measures by the government are there to support residents, the market and cooperation with the market. In the course of households the covenants *'Meer Met Minder'* (MMM) ('More With Less') and *'Energiebesparing Sociale Huursector'* ('Energy savings Social Housing sector') are relevant. Subsidies for energy saving measures and the energy label for dwellings are related to these covenants. The energy label for dwellings is an important step. The energy label improves the 'use-of-energy-awareness' of people. Secondly actual measures improve the energetic quality of the dwelling stock. Subsidies, financial and fiscal measures are there to stimulate owners and the market, see table 3.1.

Table 3.1: Stimulation measures of the government related to home improvement of households in mln euros (2009-2012)

	Stimulation measures per programme	measures 2009-2012	
		number	mln euros
1	Energy performance advice (EP/ EPA)	50.000	10
2	Subsidy for energy label steps - More with Less (MMM)	7.000	15
3	Subsidy for insulation glas - More with Less (MMM)	40.000	20
4	Subsidy for insulation glas	60.000	30
5	Energy saving credit	50.000	35
6	Energy saving support - *'Energie investeringsaftrek'* (EIA)	.	195
7	Sustainable heat - *'Duurzame Warmte'*	.	60
8	Innovation agenda Built Environment	.	30
9	**Total stimulation measures**	**207.000**	**395**

Source: (BZK, 2011)

The list of programmes makes clear that about 200 thousand households can profit from approximately 395 mln euros available in the period 2009-2012. The incumbent cabinet Rutte decided that subsidies on energy saving measures in the built environment will be phased out over the coming year (2012). The government is challenging the market with the 'Innovation agenda Built Environment' to come up with creative solutions and concepts and emphasis the importance of knowledge transfer (BZK, 2011, p.8).

4 *The energetic quality of the dwelling stock*

4.1 Introduction

Over the years the standard of living and the building quality has improved. Since the 1960s a nationwide natural gas network in the Netherlands provides the majority of households with gas for cooking and heating. The need for energy independency and rising energy prices because of the energy crisis in the 1970s meant that newly built houses were insulated. From 1995 dwellings became more energy efficient because of environmental reasons. The *'Energie Prestatie Norm'* (EPN) (Energy Performance Standard) was introduced to set a minimal standard regarding to the heat transfer through the shell of buildings. Over the years the EPN standard is tightened to improve the energetic quality of new buildings and limiting CO_2 emissions.

The introduction of the energy label is a first step to improve the energetic quality of existing buildings in the Netherlands. Since 2007 AgentschapNL is registrating all addresses with an energy label in the Energy Label Database (ELD). At the end of 2010 25% of the entire dwelling stock is represented by address in the ELD. In this chapter the usability of the ELD for the determination of the Environmental Protection Expenditures (EPE) of households is examined. The ELD contains all households that are related to dwellings from private owners (owner – occupiers) to the social and private rental sector.

With the implementation of the *'Energieprestatienorm van Gebouwen'* (EPG) (Energy Performance standard of Buildings) in July 2012 the EPN for newly built buildings and the energy label for existing buildings is replaced. The EPG according to NEN 7120 and the European EPBD set the standard for the energy performance of new buildings coming with the building permission. Also the energy label is part of the EPG and will be used for both new and existing buildings. The energy label will be used with the completion of new buildings (as check) and for the existing building stock (DWA, 2011).

4.2 *Energy label and energy performance advice (EP/ EPA)*

The energy label is first of all introduced to improve insight in the energetic quality of the building stock. Since 2008 the energy label is obliged with the transfer of dwellings. In practise this obligation is not enforced. The energy label is originally meant for dwellings older then 10 years. The idea is that the energetic quality (according to the EPN) of houses built over the last 10 years is sufficient and insulation measures are less profitable then for older dwellings. Especially dwellings built before the year 1970 can profit from insulation measures (WoON, 2010). In 2013 owners are enforced to deliver an energy label in front of the notary together with the execution (KNB, 2011). Secondly insight in the energetic quality with an energy label (EP) and insight in the possibilities to improve the energetic quality which is based on an energy performance advice (EPA) leads to actual measures.

The energy label is based on an EP or EPA advice provided by certified bodies according to the BRL9500-01/ 9501 standard. Advisors are legitimized to deliver energy labels (EP) and give 'tailor made energy saving advice' formerly known as energy performance advice (EPA). Tailor made advice contains advice on measures that can be taken to improve the energy performance like insulation and the use of alternative energy, including savings on water and electricity and payback times on investments (MilieuCentraal, 2012). Table 4.2.1 shows the total number of addresses (dwellings) that obtained an energy label (EP) or energy performance advice (EPA) in the Netherlands till 2010.

Table 4.2.1: Number of records (addresses - dwellings) in the ELD with an energy label (EP) and energy performance advice (EPA) per building period category (to 2010)

	Type of advice	Building period category				total
		<1900	1900-1970	1970-2000	2000-2010	EP/ EPA
1	EP (energy label)	2.980	269.674	347.777	27.809	648.240
2	EPA (EP & performance Advice)	8.681	496.060	600.407	60.943	1.166.091
3	**Total**	**11.661**	**765.734**	**948.184**	**88.752**	**1.814.331**

Source: Energy Label Database (AgNL-1, 2010)

From 1,8 mln records in the ELD (to 2010) 99% is related to dwellings. Less then 1% is related to utility buildings like offices which is not brought into account in table 4.2.1. From the addresses in the ELD about 648 thousand (36% of 1,8 mln) dwellings obtained an energy label. The other 1,16 mln (64%) addresses obtained a label and an energy performance advice. See also annex 1 for labels per dwelling type and year of registration.

Table 4.2.2: Number of energy labels per label type and building period category (to 2010)

	Type of label	Building period category				total EP/ EPA
		<1900	1900-1970	1970-2000	2000-2010	
1	A, A+, A++	147	1.777	5.537	34.243	41.704
2	B	1.121	22.217	112.798	41.967	178.103
3	C	2.813	105.236	397.167	10.475	515.691
4	D	2.533	218.230	284.067	1.822	506.652
5	E	2.046	206.062	99.888	182	308.178
6	F	1.674	145.937	38.771	47	186.429
7	G	1.327	66.275	9.956	16	77.574
8	**Total**	**11.661**	**765.734**	**948.184**	**88.752**	**1.814.331**

Source: Energy Label Database (AgNL-1, 2010)

The energy label type is categorizing the energetic performance of dwellings in more then 7 categories from A to G. There are 1,72 mln dwellings (95% of 1,8 mln) in the ELD built before the year 2000.

4.3 *Energy label database (ELD)*

AgentschapNL is registrating addresses with an energy label since 2007. These addresses can be related to utility buildings or dwellings. More than 99% of all labels are related to dwellings. From 1,8 mln dwellings with energy labels 983 thousand (55%) are registered in 2009. This is mainly because of housing corporations that labelled a big part of their dwelling stock in 2009. From 1,8 mln dwellings in the ELD over 1,4 mln (> 77% of 1,8 mln) belong to social housing corporations which is 60% of all dwellings in the social housing sector (CBS-5, 2010).

The Schedule of Requirements *'Interfaceversie "4.00" EPDB Database'* from Senter*Novem* describes the content of the digital monitoring system ELD (AgNL-4, 2009). The variables mentioned in the schedule are useful for determining home improvement measures although most of the variables prescribed in the Schedule of Requirements are not recorded and not present in the ELD.
In this report the assumption is that the ELD can be useful for the determination of home improvements. The improvement of the energy label is an indication for measures that are taken by dwelling owners/ households. The 'energy label jump' and the measures that are taken to reach the jump on the energy ladder are an indication for home improvements. 5 dwelling types (since 2010 there are 8 dwelling types) are registered. Table 4.3 is showing the number of dwellings with an improved energy label per dwelling type in 2009.

Table 4.3: Number of improved energy labels and jumps on the energy ladder per dwelling type (in 2009)

	Dwelling type	Label and label steps*										total number of labels	total* number of label steps
		A	A*	B	B*	C	C*	D	D*	E	E*		
1	Detached	0	0	1	5	0	0	0	0	1	0	**2**	**5**
2	Semi-detached	2	2	2	5	14	30	4	8	4	2	**26**	**47**
3	Terrace house	1	2	5	6	8	13	10	11	2	2	**26**	**34**
4	Block of flats (entrance hall)	3	3	54	73	64	77	40	55	39	24	**200**	**232**
5	Gallery flats	3	3	31	51	35	40	17	25	20	13	**106**	**132**
6	**Total**	**9**	**10**	**93**	**140**	**121**	**160**	**71**	**99**	**66**	**41**	**360**	**450**

Source: Energy Label Database (AgNL-1, 2010)

* Label steps, number of jumps on the energy ladder

Till 2009 only 360 addresses/ dwellings (0,02% of 1,8 mln) in the ELD are labelled twice according to the date of registration. From 360 dwellings there are 191 (53%) labelled twice in the same year (2009). Another 167 dwellings (46%) are labelled first in 2008 and for the second time in 2009. Only 2 dwellings are labelled in 2007 for the first time. More than 300 dwellings (85%) are apartments in gallery flats or blocks of flats with an entrance hall.

When the dwellings are multiplied with the actual jumps that are made on the ladder (*) the total number of jumps is 450. This means that the average jump on the energy label ladder is 1,25. The majority, 262 dwellings (73%), made only one jump. Another 98 dwellings (27%) took measures and improved with 2 jumps or more on the ladder. Notable is that the actual improvement per dwelling type (the number of jumps on the ladder) is higher for houses than for apartments and flats.

4.4 Conclusion

The energy label database (ELD) can be a useful source for making statistics and time series in the future (AgNL-1, 2010). Because of the number of records and recorded variables like dwelling type, surface- area, energy label and year of building the ELD is an important source for research on the energetic quality of the dwelling stock. Also general conclusions that come with the EPA advice are an indication for the possibility to improve the energetic quality per dwelling type and building period. Other variables in the ELD like the energetic performance and heating system are also useful for determining home improvements but are depending on the differentiation and quality of measuring and recording (AgNL-2, 2011).

The assumption that the energy label jump can be used for determining the improved energetic quality of dwellings and the environmental protection expenditures (EPE) of households regarding to home improvement is not right for 2009. The number of dwellings (360) in the ELD that are labelled twice by 2009 is too small for determining EPE. Also the variables that can be used are not sufficient for determining the exact measures. In the Schedule of Requirements *'Interfaceversie "4.00" EPDB Database'* (the action plan for the ELD) there are much more variables described than actually presented in the ELD. For example variables regarding to the insulation (shell) and installations (solar panels, heat pumps, etc.) of dwellings and offices are missing.

In the near future the energy label jump probably can be an indicator for taken home improvement measures. More and more dwellings are labelled and labelled twice. Hopefully existing variables are improved and useful variables are added to the ELD in the future. In 2013 energy labelling is standard for all dwellings existing and new. The ELD eventually will be filled with (almost) all dwellings in the dwelling stock. In 2012 for example over 2 mln dwellings have an energy label and over 47 thousand dwellings improved their label meeting the standards of *'MeerMetMinder'* (MMM) ('More With Less').

The possibility to make statistics and time series from home improvement measures in the dwelling stock is depending on the quality of the labels in the ELD. The ELD does not lead to determination of EPE in 2009. In the next chapter other sources are used to determine home improvement measures and related EPE.

5 *Improvement of the dwelling stock and EPE*

5.1 Introduction

The determination of the EPE of households is based on external research and two reports of Statistics Netherlands. For the insulation of the shell of dwellings the report 'EPE in the Building Industry' is used (CBS-6, 2011). The report 'Renewable energy in the Netherlands 2010' contains information about solar energy and heat pumps in relation to the built environment (CBS-7, 2011).

For the number of measures that are actually taken to improve the energetic quality of the dwelling stock research of TNS – Nipo (2009) and Intomart GfK (2010) is used (AgNL-3, 2010). Both researches are examining the quality of the building stock and energy saving measures taken in 2008 and 2009 in the Netherlands. By means of surveys public housing corporations (TNS – Nipo) and private owners (Intomart GfK) are asked for the measures that are taken to improve the energetic quality of their dwelling or dwelling stock. This research is commissioned by SenterNovem/ AgentschapNL and the Ministry of Housing, Spatial Planning and the Environment (VROM).

In this chapter the number of insulation and installation measures in the dwelling stock is given together with information about the added renewable energy installations in 2008 and 2009. Characteristics of the shell of dwelling types are used from the research 'EPE in the Building Industry' to determine the insulation measures regarding to dwelling ownership category.
The number of measures together with specific characteristics of the dwelling stock and price per unit are used for the determination of the environmental protection expenditures EPE in chapter 5.3.

In this report the investments in environmental related measures that improve the dwelling stock are equivalent to the environmental protection expenditures of households on the subject of home improvement.

5.2 *Insulation and installation measures*

Surveys of TNS – Nipo and Intomart GfK regarding to home improvement measures useful for the EPE of households falls apart in two main categories 1/ insulation and 2/ installation measures. The first four measures in the table below are related to insulation measures of the shell of dwellings. The second four measures are related to the use of warm water and for central heating. Central heating with a separate boiler (gas) in every dwelling is standard for Dutch households. Over the years boilers became more energy sufficient so called *'Hoog Rendement'* (HR) (high efficiency). With the use of alternative energy like (geothermal) heat pumps, solar collectors and photovoltaic the energy performance of dwellings will be further increased. In table 5.2.1 the result of both surveys is given.

Table 5.2.1: Number of home improvement measures taken by the private and public sector (2008 and 2009)

	Measures	private	rental sector			measures 2008 - 2009	
		sector	public	private	total	number	%
1	Double/ HR+ glazing	159.893	62.850	28.749	91.599	**251.492**	39,1%
2	Cavity wall insulation	57.983	18.372	3.026	21.398	**79.381**	12,3%
3	Roof insulation	70.283	6.053	28.041	34.094	**104.377**	16,2%
4	Ground floor insulation	51.833	21.272	7.566	28.838	**80.671**	12,5%
5	Central heating (boilers)	57.983	30.942	13.618	44.560	**102.543**	15,9%
6	Heat pump	8.785	1.934	1.513	3.447	**12.232**	1,9%
7	Solar thermal collector	2.636	2.901	.	2.901	**5.537**	0,9%
8	Photovoltaic	6.150	967	.	967	**7.117**	1,1%
9	**Total**	**415.546**	**145.291**	**82.513**	**227.804**	**643.350**	**100,0%**

Source: TNS NIPO (2009) and GfK Intomarkt (2010)

In the report of Statistics Netherlands 'Renewable energy in the Netherlands 2010' the yearly added renewable energy is examined. The total number of heat pumps, solar thermal collectors and photovoltaic added in 2008 and 2009 is given in table 5.2.2.

Table 5.2.2: Number of added renewable energy per type of installation (2008 and 2009)

	Type of installation added	2008		2009		2008-2009
		number	%	number	%	number
1	Heat pump soil	3.323	.	4.560	.	7.883
2	Heat pump air	4.308	.	3.698	.	8.006
3	Solar thermal collector	7.284	38,7%	11.522	61,3%	18.806
4	Photovoltaic	4.444	29,4%	10.669	70,6%	15.113
5	**Subtotal heat pump (1+2)**	**7.631**	**48,0%**	**8.258**	**52,0%**	**15.889**
6	**Total (3+…+5)**	**19.359**	**38,9%**	**30.449**	**61,1%**	**49.808**

Source: Statistics Netherlands e.a. (2011)

The survey of TNS – Nipo and Intomart GfK (table 5.2.1) are based on two years 2008 and 2009 and covers the dwelling stock (AgNL-3, 2010). Research of Statistics Netherlands in the report 'Renewable energy in the Netherlands 2010' is on yearly bases. In table 5.2.2 only for heat pumps the numbers are related to dwellings. For solar panels (thermal collectors and photovoltaic) (3+4) total numbers are given for all added installations in the Netherlands meaning dwellings, utility buildings and other applications. The numbers in table 5.2.2 are not differentiated for the existing dwelling stock and newly built dwellings.
When the numbers of table 5.2.1 and 5.2.2 are compared the following percentages are found: 12.232 heat pumps (77% of 15.889), solar thermal collectors 5.537 (29,4% of 18.806) and 7.117 photovoltaic (47,1% of 15.113) are installed in two years in the dwelling stock. Because the distribution over dwellings and offices and existing and new buildings is not made for solar panels in the report of Statistics Netherlands the number of solar panels is substantially higher which leads to lower percentages for solar panels when the numbers of TNS – Nipo and Intomart GfK are compared with research of Statistics Netherlands (CBS-7, 2011).

5.3 Environmental Protection Expenditures (EPE)

The environmental protection expenditures in this report are calculated on basis of the number of measures in table 5.2.1 and 5.2.2. The investments to improve the dwelling stock are calculated as EPE with combined results of TNS – Nipo, Intomart GfK and Statistics Netherlands. Research of Statistics Netherlands regarding to the building industry and the insulation of the shell of standardized dwellings in 2011 is used for the determination of dwelling characteristics (m^2) (CBS-6, 2011). Per main category like defined in chapter 2, table 2.1, the EPE can be ascribed to three ownership categories: 1/ private owner - occupier (table 5.3.1), 2/ public housing corporations (table 5.3.2) and 3/ the private rental sector (table 5.3.3). For installations (heat pumps and solar panels) the numbers are used as mentioned in table 5.2.1. To make the division over the years 2008 and 2009 for the EPE in 2009 the percentages related to the figures in table 5.2.2 are used.

Table 5.3.1: Number of home improvement measures taken by private owner - occupiers and EPE in euros (2009)

	Measures by owner - occupiers	A/ number of measures *	B/ characteristics per dwelling	C/ factor	D/ costs	E/ unit	F/ (A*B*C*D*E) EPE in euros	%
1	Double/ HR+ glazing	159.893	33,40 m^2	0,25	20	€ / m^2	26.700.163	13,9%
2	Cavity wall insulation	57.983	62,02 m^2	0,5	20	€ / m^2	35.963.376	18,7%
3	Roof insulation	70.283	48,93 m^2	0,5	20	€ / m^2	34.388.359	17,9%
4	Ground floor insulation	51.833	37,92 m^2	0,5	20	€ / m^2	19.656.615	10,2%
5	Central heating	57.983	1 st	0,13	1.500	€ / st	10.871.813	5,7%
6	Heat pump	8.785	1 st	0,52	10.000	€ / st	45.658.336	23,8%
7	Solar thermal collector	2.636	1 st	0,61	3.600	€ / st	5.814.058	3,0%
8	Photovoltaic	6.150	1 st	0,71	3.000	€ / st	13.024.750	6,8%
9	**Total**	**415.546**					**192.077.470**	**100,0%**

Source: TNS NIPO (2009) and GfK Intomarkt (2010), Statistics Netherlands and Energieverbruiker.nl

* Column A/ Number of measures is based on 2008 and 2009

Table 5.3.2: Number of home improvement measures taken by public housing corporations and EPE in euros (2009)

	Measures by housing corporations	A/ number of measures *	B/ characteristics per dwelling	C/ factor	D/ costs	E/ unit	F/ (A*B*C*D*E) EPE in euros	%
1	Double/ HR+ glazing	62.850	17,12 m^2	0,25	20	€ / m^2	5.378.484	14,4%
2	Cavity wall insulation	18.372	31,79 m^2	0,5	20	€ / m^2	5.839.644	15,6%
3	Roof insulation	28.041	27,69 m^2	0,5	20	€ / m^2	7.765.273	20,7%
4	Ground floor insulation	21.272	23,86 m^2	0,5	20	€ / m^2	5.075.520	13,6%
5	Central heating	30.942	1 st	0,07	1.500	€ / st	3.197.369	8,5%
6	Heat pump	1.934	1 st	0,29	10.000	€ / st	5.539.593	14,8%
7	Solar thermal collector	2.901	1 st	0,34	3.600	€ / st	3.526.344	9,4%
8	Photovoltaic	967	1 st	0,39	3.000	€ / st	1.128.662	3,0%
9	**Total**	**167.279**					**37.450.889**	**100,0%**

Source: TNS NIPO (2009) and GfK Intomarkt (2010), Statistics Netherlands and Energieverbruiker.nl

* Column A/ Number of measures is based on 2008 and 2009

Table 5.3.3: Number of home improvement measures taken by the private rental sector and EPE in euros (2009)

	Measures by private rental sector	A/ number of measures *	B/ characteristics per dwelling	C/ factor	D/ costs	E/ unit	F/ (A*B*C*D*E) EPE in euros	%
1	Double/ HR+ glazing	28.749	27,64 m^2	0,25	20	€ / m^2	3.972.954	19,7%
2	Cavity wall insulation	3.026	51,33 m^2	0,50	20	€ / m^2	1.553.227	7,7%
3	Roof insulation	6.053	45,82 m^2	0,50	20	€ / m^2	2.773.550	13,8%
4	Ground floor insulation	7.566	35,62 m^2	0,50	20	€ / m^2	2.695.232	13,4%
5	Central heating	13.618	1 st	0,11	1.500	€ / st	2.247.140	11,1%
6	Heat pump	1.513	1 st	0,46	10.000	€ / st	6.920.425	34,3%
7	Solar thermal collector	.	.	.	.	.	.	.
8	Photovoltaic	.	.	.	.	.	.	.
9	**Total**	**60.525**					**20.162.528**	**100,0%**

Source: TNS NIPO (2009) and GfK Intomarkt (2010), Statistics Netherlands and Energieverbruiker.nl

Column A/ The kind of measures in relation to the number of measures is given according to the surveys of TNS –Nipo and Intomart GfK for the years 2008 and 2009 (tables 5.3).

Column B/ On basis of characteristics of dwelling types (surface area shell) assigned to ownership relations in the dwelling stock the average surface area of the shell for the calculation of the EPE on insulation measures is given. Dwellings in the category private owner – occupier are relative large, the total surface area of the shell of dwellings in this category is given 33+62+49+38 (=183 m^2). The surface area of the shell of dwellings in the category public housing is 17+32+28+24 (=101 m^2) and for the private rental sector 28+51+46+36 (=160 m^2). The characteristics of the shell are used in the calculation of the EPE for insulation measures per type of shell/ material and dwelling category. For the installation measures the surface area is also brought into account. This is done because of the assumption that installation measures (for heating) per dwelling category are in proportion with the size of dwellings, see column C/.

Column C/ is introduced for several scaling effects. First of all the measures from surveys of TNS – Nipo and Intomart GfK are about the years 2008 and 2009. For this reason the number of insulation measures and central heating (1 to 5) is factorized by 0,5 to get the numbers for the year 2009. For the division of installation measures over the years 2008 and 2009 the percentages (table5.2.2) from the report 'Renewable energy in the Netherlands 2010' is used on the number of measures in table 5.2.1. From the installed heat pumps, solar thermal collectors and photovoltaic in 2008 and 2009, 52% of the heat pumps, 61% of the solar thermal collectors and 71% of the photovoltaic is installed in 2009. The under column B/ mentioned proportionality regarding to the size of dwellings per ownership category is used to scale installation measures in table 5.3.2 and 5.3.3. The costs for installation measures per unit (column D/ E/) are based on the category 'private ownership' so the installation measures (5 to 8) for the dwelling ownership

categories 'public housing' and 'private rental sector' are scaled with (101/183=) 55% (table 5.3.2) and (160/183=) 88% (table 5.3.3). Another assumption is that for double/ HR+ glazing the factor (0,5) is used to express that dwelling owners only partly replaces existing glazing. This is because a lot of houses are already provided with double glazing for example on the ground floor. So in the calculation is assumed that 50% of the glazing in a dwelling is double/ HR+ glazing. Other insulation measures are taken for the full 100%, so whole of the cavity wall, roof and ground floor is insulated. Regarding to the definition of EPE for central heating/ boilers only the extra costs are counted as environmental protection expenditures. The extra costs for more energy efficient central heating equipment (measure 5) are 25% in this calculation. All other measures are seen as additional measures for which investments in the EPE count for 100%, with the note that only the extra costs that are involved are charged.

Column D/ and E/ The costs for insulation measures, for the materials and bringing on the materials, is stated on 20 €/m². In case of double/ HR+ glazing the average price is 50 €/m², normal glass is 30 €/m², the difference 20 €/m² is brought into account as EPE. The same is done for heat pumps. Heat pumps often work together with central heating systems or replace them but both with the purpose of heating dwellings. Only the extra average costs of heat pumps (€10.000,- per installation) compared with standard central heating systems are brought into account for the EPE. Solar panels count as renewable or alternative energy for the full 100% in the EPE. The costs for materials and bringing on insulation materials are based on standard indicators for installation measures also the internet site Energieverbruiker.nl is used (ENER, 2012).

Column F/ The costs per unit (column D/) are based on average prices per m² for insulation and per installation (column E/) including (re-)placing the product. The variables (A*B*C*D*E) in column F are factorised and the costs per measure and dwelling ownership category is given.

5.4 Conclusion

Home improvement measures of households and the determination of the EPE is based on several researches and surveys. The energetic performance of the dwelling stock is an important point of interest of the government. For this report Statistics Netherlands is depending on research of AgentschapNL (formerly known as SenterNovem) and the Ministries. The Environmental Protection Expenditures for 2009 are derived and composed with research that took place over 2008 and 2009. Surveys of TNS – Nipo and Intomart GfK give insight in the measures taken to improve the dwelling stock. Because the distinction is made between ownership relations Statistics Netherlands can use this distinction to divide and ascribe EPE with respect to the NACE. Measures taken by social housing corporations and the private rental sector can be ascribed to NACE-68.

The calculation of the EPE is based on assumptions regarding the dwelling stock and the definition of environmental expenditures and costs related to measures taken. The number of measures is related to survey research in 2008 and 2009. For the calculation of insulation measures and central heating in 2009 the number of measures is divided by 2 to get an average. For insulation measures and central heating no other sources are used. The difference in spending over 2008 and 2009 is not brought into account for these measures.
For measures related to sustainable energy; heat pumps and solar panels the number of measures is combined with the results from the report 'Renewable energy in the Netherlands 2010'. This combination contributes to a better estimation for the number of measures that are taken in 2009. The total added number of heat pumps (soil and air) in the report is 8.258 in 2009 (+8% compared with 2008). For thermal collectors the added surface in 2009 is 34 thousand m² (+70%) and for photovoltaic 76 thousand m² (+143%).

The conclusion is that the expenditures on insulation measures are over 60% of all calculated expenditures. Less than 40% of the EPE is related to installations and renewable energy sources like heat pumps and solar panels. Nevertheless the use of renewable energy is increasing over

the years. Since the year 2000 the number of yearly added heat pumps is multiplied by ten. For thermal collectors the added power is more than doubled and for photovoltaic the increase is fivefold (CBS-7, 2011).

6 *Conclusion*

In this report the environmental protection expenditures (EPE) on home improvement measures of households are based on investments in the dwelling stock. Surveys of TNS – Nipo and Intomart GfK are used for this report commissioned by AgentschapNL and is carried out over the years 2008 and 2009 (AgNL-3, 2010). The surveys are useful because off 1/ the number of measures mentioned for insulation and installation and 2/ it provides a breakdown of ownership relations, meaning by private owner - occupiers, public housing and the private rental sector. The breakdown of ownership relations and the responsibility for home improvement measures is useful for ascribing EPE not only to households but also for sectors like NACE-68 (rental and social housing). For the number of installation measures (heat pumps and solar panels) additional research 'Renewable energy in the Netherlands 2010' of Statistics Netherlands is used. In this final conclusion the results of all calculated EPE (chapter 5) related to the home improvement of households is given, table 6.1.

Table 6.1: Total EPE of households on insulation and installation measures in mln euros (2009)

	Measures	EPE households mln euros	%
1	Insulation - Double/ HR+ glazing	36	14,4%
2	Insulation - Cavity wall insulation	43	17,4%
3	Insulation - Roof insulation	45	18,0%
4	Insulation - Ground floor insulation	27	11,0%
5	Installation - Central heating	16	6,5%
6	Installation - Heat pump	58	23,3%
7	Installation - Solar thermal collector	9	3,7%
8	Installation - Photovoltaic	14	5,7%
9	**Subtotal insulation (1+…+4)**	**152**	**60,8%**
10	**Subtotal installation (5+…+8)**	**98**	**39,2%**
11	**Total (9+10)**	**250**	**100,0%**

Source: Statistics Netherlands, table 5.3.1, 5.3.2 and 5.3.3

The total investments on home improvement measures are 250 mln euros and in this report equivalent to the environmental protection expenditures of households in 2009. To determine the environmental burden of households the subsidies as stated in chapter 3 are deducted. In table 6.2 the EPE for insulation and installation measures are given separately together with the stimulation measures of the government.

Table 6.2: Burden, EPE and subsidies of households in mln euros (2009)

	EPE households and stimulation measures	mln euros	%
1	EPE - Households: Insulation	152	60,8%
2	EPE - Households: Installation	98	39,2%
3	Subsidies related to insulation	39	39,2%
4	Subsidies related to installation	41	41,8%
5	Other subsidies and fiscal measures	19	19,0%
6	**Subtotal EPE (1+2)**	**250**	**100,0%**
7	**Subtotal subsidies (3+…+5)**	**99**	**100,0%**
8	**Total burden households (6 - 7) ***	**151**	**60,5%**

Source: Statistics Netherlands table 3.1, table 6.1

* Burden (%) expressed as percentage of EPE

The environmental burden for households regarding to the improvement of the dwelling stock in the Netherlands is 151 mln euros (60% of 250 mln) in 2009. The total amount of EPE 250 mln euros is reduced with stimulation measures of the government 99 mln (40% of 250 mln). The

stimulation measures are determined by dividing the total amount for the period 2009-2012 of 395 mln euros (table 3.1) by 4. The distinction between stimulation programmes for insulation and installation measures is an indication because most subsidies are not ascribed to specific measures. Sometimes subsidies are ascribed to specific programmes (like double glazing) but for the EIA-programme both insulation and installation measures are possible. Looking at table 6.2 the EPE related to insulation measures 152 mln euros (61% of 250 mln) is more than EPE related to installation measures 98 mln euros (39% of 250 mln). The stimulation of insulation and installation measures with subsidies of the government is about the same (40%) according to the figures in table 6.2. In 2009 it is more common to take conventional measures in the dwelling stock like insulating the shell of dwellings than to invest in renewable energy.

There are several recommendations for further research. First of all the subject of home improvement and improving the energetic quality of the built environment has the attention of the government and AgentschapNL. An example is *'Monitoring Meer met Minder'* (MMM) (Monitoring More with Less) research carried out by ECN and Buildsight which is more specific than the surveys of TNS – Nipo and Intomart GfK on the kind of measures that are taken to improve the energetic quality of the building stock. A point of interest is the application of heat pumps. In the calculation of the EPE in this report the share of heat pumps is with 58 mln euros (23,3% of 250 mln) quite high. Although heat pumps are expensive investments it is possible that the division of heat pumps over the application in newly built buildings and existing buildings can be improved. Regarding to statistics and time series better insight in specific stimulation measures (insulation and installation) of the government is needed. 40% off all costs related to home improvement are subsidised. A substantial part of households/ dwelling owners will (only) invest if there is some sort of allowance.
Especially for statistics and determining EPE before 2010 insight in subsidies is useful. From 2010 and further on the usability of the ELD with 'jumps on the energy ladder' should be further examined. Because of the number of records the ELD can be useful for statistics and time series. Regarding to the responsibility for home improvement and the classification for statistics it is worthwhile to look at ownership categories like NACE-68.

Final remarks: With the EPG/ NEN 7120 it is possible to join the European EPBD standard, more consistency is introduced in the calculation of the EPC (energy performance of buildings) and the energy label and between dwellings and utility buildings. In addition of the EPG a future possibility is to bring into account *'Energie Maatregelen Gebied'* (EMG) (Area Energy Measures) according to NVN 7125. A more comprehensive approach for the planning and calculation of the energy efficiency of the built environment is given with the new standard.
Energy and water saving measures of households are not only depending on the measures that are taken to improve the (environmental) standard of living. Also the awareness and the way people use facilities are important. Except from the Energy label there are several other initiatives to improve the awareness of users in the built environment. Development of public-private partnership on a local level, like municipalities and housing corporations, is necessary to change the behaviour patterns and to stimulate innovation. The EU considers the use of an obliged water label and product related water labels (e.g. for toilets and showers) for the use of water within buildings and to combat the spill of water. The 'smart energy meter' is mentioned as important for behavioural changes and keystone in the development of decentralised energy generation and 'smart grids' (BZK, 2011, p.4).

A comment on all efforts related to energy saving is that the Rathenau Institute concludes in their report 'Energy in 2030: Decisions for today's society' that there are seven myths in the Dutch energy debate, including the idea that greater energy efficiency leads to less energy consumption. The example that is given is directly related to the energy consumption of households. The revenues of energy savings are leading to more energy consumption (Rath, 2011).

Annex

Annex 1: Number of addresses/ dwellings with an energy label per dwelling type (*1000) (to 2010)

	Dwelling type	2007	2008	2009	2010	Total
1	Residental building (non-autonomous)	x	x	x	0,9	**0,9**
2	Detached	0,7	8,3	5,0	13,2	**27,2**
3	Semi-detached	8,7	111,7	182,4	58,2	**360,9**
4	Terrace house	11,3	150,9	282,4	84,3	**529,0**
5	Block of flats with an entrance hall	7,4	97,6	242,8	63,5	**411,3**
6	Maisonette	x	x	x	7,6	**7,6**
7	Gallery flat	11,4	108,3	270,7	69,7	**460,1**
8	Flat/ apartment	x	x	x	5,7	**5,7**
9	**Total (*1000)**	**39,6**	**476,7**	**983,2**	**303,2**	**1.802,7**

Source: Energy Label Database (AgNL-1, 2010)

Annex 2: Estimation of dwelling types per ownership category in percentages

	Dwelling type	Ownership category			total
		private sector	rental sector		
			public	private	
1	Detached	95%	2%	3%	100%
2	Semi-detached	80%	15%	5%	100%
3	Semi-detached	70%	22%	8%	100%
4	Terrace house	70%	22%	8%	100%
5	Block of flats (entrance hall)	31%	67%	2%	100%
6	Gallery flats	20%	77%	3%	100%
7	X Other	20%	35%	45%	100%

Source: Statistics Netherlands

Annex 3: Estimation of number of dwellings per ownership category

	Dwelling type	Ownership category			total
		private sector	rental sector		
			public	private	
1	Detached	962.350	20.260	30.390	1.013.000
2	Semi-detached	719.840	134.970	44.990	899.800
3	Semi-detached	617.260	193.996	70.544	881.800
4	Terrace house	1.311.030	412.038	149.832	1.872.900
5	Block of flats (entrance hall)	182.838	395.166	11.796	589.800
6	Gallery flats	322.500	1.241.625	48.375	1.612.500
7	X Other	25.320	44.310	56.970	126.600
8	**Total**	**4.141.138**	**2.442.365**	**412.897**	**6.869.800**

Source: Statistics Netherlands

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and per dwelling type;
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=7409WBO&D1=0,9-12,14&D2=0&D3=17-18&D4=a&HDR=G3&STB=G1,G2,T&VW=T

and per home improvement measure;
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=7409WBO&D1=40-59&D2=0&D3=17-21&D4=a&HDR=G3&STB=G1,G2,T&VW=T

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