W/E report

CO_2-emission calculations for the Second Green Bond of ABN-AMRO

W/E 9047
Utrecht/Eindhoven, 13 May 2016

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Project
W/E 9047

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1 Impact calculations ABN AMRO Green Bond

As requested by ABN AMRO, W/E consultants have calculated the CO_2 impact indication of the assets which will be incorporated in the second ABN AMRO Green Bond.

The next chapters contain the relevant questions and W/E has provided answers and opinions based on best practices and our experience. The process of finding the answers and the assumptions that have been made in that process will be discussed in the 'Methodology' section.

At the request of ABN AMRO we will report on a number of core indicators for building projects in accordance with the 'harmonized framework for impact reporting' (version December 2015) which is developed by a group of multilateral development banks including IFC, EIB, Worldbank and others[a]

Results

Within the ABN AMRO green bond framework 2.0, three different project categories can be distinguished. For each of these categories, the annual CO_2 savings (compared to a relevant national benchmark) have been calculated. For all assets within the green bond combined, the annual savings are just over 7,500 ton.

Total CO2 savings, in ton/year		ton/million euro
category	2016	2016
Category A - residential dwellings	2.913	6,7
Category B - pv loans	2.383	288,1
Category C - commercial real estate	2.268	39,9
Total	7.565	15,1

Reporting table in line with harmonised framework

Renewable energy & Energy efficiency	Type	Signed Amount	Share of Total Portfolio Financing	Eligibility for green bonds	Allocated Amount	Average portfolio financial lifetime	#1) Annual energy savings		#3) Annual generation	#4) a) Renewable energy capacity added	#2) Annual GHG emissions reduced/avoided e/
Portfolio name		*EUR*	*%*	*%*	*EUR*	*years*	*kWh/m2*	*GJ*	*MWh*	*MW*	*in tonnes of CO2 equivalent*
Green Loans	RE	9.048.553	100%	100%	8.272.147	11,7	-	-	5.900	6,74	2.383
Residential Mortgages	EE	480.068.447	100%	100%	434.810.649	10+	89	57.562	-	-	2.913
Commerical Real Estate	EE	135.883.000	100%	100%	56.917.204	3,4	97	45.956	-	-	2.268
Total		**625.000.000**	**100%**	**100%**	**500.000.000**		**186**	**103.518**	**5.900**	**6,74**	**7.565**

Note: Energy savings are given as savings in primary energy, not as energy consumption "on the meter".

[a] http://treasury.worldbank.org/cmd/pdf/InformationonImpactReporting.pdf

Project category A
Mortgage loans for energy efficient residential buildings

A.1. Achieved energy efficiency of buildings

Methodology

ABN AMRO has selected 1,760 dwellings to be part of this Green Bond. Within this assessment, we determined the energy usage of these dwellings and compared this to the average Dutch dwelling. The energy usage is calculated using the energy performance method as depicted in the Dutch 'Building Decree 2012'. Even though there is a difference between calculated and actual energy use, especially when looking at a single building or dwelling, we are of the opinion that for a large portfolio of dwellings there is a good match between theory and practice for new dwellings[b].

For the Dutch average, we used data from CBS, the Dutch Central Bureau for Statistics (Table 15).

EPC

All new buildings in The Netherlands need to comply with an energy performance requirement, set by the Dutch 'Building Decree 2012'. This requirement is expressed in terms of the Energy Performance Coefficient ("EPC[c]"). We refer to Table 14 for more information on EPC requirements.

The EPC is an indicator for the primary energy performance of a building. This only comprises building related energy use for space heating and cooling, domestic hot water, ventilation, fans and lighting. It also takes renewable energy installations into account. More information can be found at http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/energieprestatie-epc/bepalingsmethode.

'Primary' means that the energy demand of a dwelling within the EPC relates to the fossil energy demand. For electricity use, this means that the efficiency of the Dutch power production and power grid is taken into account (set at 39%[d] within the calculation method). For example, a dwelling with an electricity bill of 3,000 kWh will have a primary energy demand of 3,000/39% = 7,692 kWh. For natural gas, the efficiency of the grid (transportation, distribution) is set at 100%. So a dwelling with a gas bill of 1,000 m^3 will also have a primary gas demand of 1,000 m^3, which is equivalent (for Dutch gas) with 35,17 GJ[e] or 9,769 kWh.

Data dwellings with a loan from ABN AMRO

All eligible loans were build according to the requirements in the 'Building Decree' and therefore have an Energy Performance Coefficient (EPC) of 0,6 (or lower). The EPC-requirement ≤ 0.6 came into effect on 1 January 2011. On 1 July 2012, a new determination method for the EPC was introduced (NEN 7120). To make sure that all dwellings within the bond meet this requirement and

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[b] http://www.energievastgoed.nl/2013/02/otb-delft-energielabel-voorspelt-gasverbruik/?doing_wp_cron=1429005389.5604948997497558593750

[c] In international context, the abbreviation EPC may also refer to Energy Performance Contracting of Energy Performance Certificate, (which in the Netherlands is known as an 'energy label')

[d] NEN 7120+C2/C3, C4, C5, "Energy performance of buildings -Determination method, 2012", table 5.4

[e] See for example http://www.rvo.nl/sites/default/files/2013/10/Heslinga%202006%20%28NL%29%20Vaststellingsmethodieken%20voor%20CO2%20emissiefactoren%20van%20aardgas%20in%20Nederland.pdf

fulfil the criteria of the Dutch Building Decree, only mortgages are selected by ABN AMRO for which the date of the initial offer to the house owner lies after 1 January 2014.

There is no detailed information available on the individual type and size of the dwellings. It is therefore assumed that the distribution of type and size of the 1,760 dwellings is equal to the average type and size of all new Dutch dwellings. Information on the average dwellings is used from 'Reference dwellings 2013' published by RVO[f].

Data average dwellings in the Netherlands

The average energy consumption of *privately owned* dwellings in the Netherlands[g] [h] is about 3,550 kWh of electricity and 1,635 m^3 of natural gas (equivalent). The figure for natural gas has been corrected for weather conditions, as gas is mainly used for space heating. Roughly 5% of all Dutch dwellings has a connection to a district heating system, but in newly built areas this percentage is significantly lower. For this assessment, the use of district heating has been neglected.

Combination data ABN AMRO and average NL

We use dwelling data and the energy performance formula to calculate the primary energy usage for gas.

CO_2-emissions - natural gas

The CO_2 emissions[i] of Dutch natural gas are 56.4 kg/GJ or 1.78 kg/m^3.

CO_2-emissions - electricity

There are different values of the carbon intensity in kg per produced kWh of electricity depending on assumptions made in the calculation method. For this assessment we use the same method as ABN AMRO applies in its Annual Sustainability Report, which is assured by KPMG. These figures (also specifically for The Netherlands) are provided by the UK Department for Environment, Food and Rural Affairs[j].

For 2015, the specific CO_2-emission is 0,39895 kg/kWh. This number does not include CO_2-emissions related to transmission and distribution of electricity.

Percentage of residential buildings that obtained an Energy Performance Certificate by NL Agency with a minimum energy performance labelled „A“ (on a scale from G-A)

All residential buildings built in 2006 are required to make an EPC calculation which should be below a value of 0.8. All these buildings will have an energy label “A”. The formal calculation method is described in "Rekenmethodiek definitief energielabel inclusief indeling energielabelklassen (versie 1.2)". The document "Tabellen met referenties inclusief labelklasse per referentie (versie 2.0)" shows that all buildings within the bond have an A-label. Figure 1 shows a copy of the relevant part of this document.

Given the EPC requirements in the Building Decree 2012, the dwellings within the Green Bond have an energy performance coefficient that is least 25% lower (= better) than the requirement for obtaining an energy label 'A'.

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[f] http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/energieprestatie-epc/referentiewoningen

[g] http://www.klimaatmonitor.databank.nl/Jive?sel_guid=b5e93327-de59-4ac8-b56c-1d0e8a6cfd80

[h] http://www.klimaatmonitor.databank.nl/; screen dump in Annex

[i] http://www.rvo.nl/sites/default/files/2014/08/Zijlema%202013%20Berekening%20CO2-emissiefactor%20aardgas%20jaar%202014.pdf

[j] http://www.ukconversionfactorscarbonsmart.co.uk/. Figure for 'Overseas electricity The Netherlands'

Figure 1 *Energy labels for each reference dwelling, including building period (copy of "Tabellen met referenties inclusief labelklasse per referentie (versie 2.0)"*

Labelklassen per referentie

De labelklassen zijn berekend met 'Rekenmethodiek definitief energielabel', versie 1.2 d.d. 16 september 2014
Bij het type flat/appartement is in tabel 3 uitgegaan van het subtype 'tussen midden', de meest voorkomende variant.
Voor de maisonnette is dat het subtype 'tussen dak' tot bouwjaar 1992, vanaf bouwjaar 1992 'hoek dak'.
In tabel 4 zijn de labelklassen opgenomen van alle subtypen.

WONINGTYPE **(C)**		BOUWPERIODE **(J)**									
		T/M 1945	1946-1964	1965-1974	1975-1982	1983-1987	1988-1991	1992-1999	2000-2005	2006-2013	2014 en later
		J1	***J2***	***J3***	***J4***	***J5***	***J6***	***J7***	***J8***	***J9***	***J10***
Vrijstaande woning		G	F	D	C	C	B	B	B	A	A
Twee / één kapwoning		G	F	D	C	C	C	B	B	A	A
Rijwoning hoek		G	F	D	C	C	C	B	B	A	A
Rijwoning tussen		F	E	C	C	C	C	B	A	A	A
Meergezinswoning	Flat/appartement*	G	E	E	B	C	C	C	B	A	A
	Maisonnette**	F	E	C	B	C	C	A	A	A	A

Tabel 3 *Labelklasse per woningtype en bouwperiode*

All relevant documents are available at RVO at request[k].

Impact indicator 1: Energy performance

Average energy consumption of residential buildings (in kWh/m^2) financed through the loans compared to the average energy consumption of residential buildings in the Netherlands.

Figure 2 *Energy consumption and CO_2 emissions ABN AMRO loans compared to average of Dutch residential buildings.*

parameter	unit	average NL	ABN-AMRO	saving	% saving
number of dwellings = households (hh)	hh	1.760	1.760		
Energy performance coëfficiënt (EPC)	-	EI = 1,59	EPC = 0,60		
average user area	m2	102	102		
average loss area	m2	193	193		
average consumption electricity	kWh/hh.year	3.550	3.550		
	kWh/m2	35	35		
average consumption natural gas	m3/hh.year	1.635	705	930	-57%
	m3/m2.year	16	7	9	
	kWh/m2.year	157	68	89	
average consumption electricity + natural gas	kWh/m2.year	192	103	89	-47%
primary energy use	GJ/year	158.787	101.225	57.562	-36%
	MJ/m2.year	888	566	322	
	kWh/m2.year	247	157	89	

Impact indicator 2: CO_2 emissions performance

Average CO_2 emissions of residential buildings (in kg/m^2) financed through the loans compared to the average CO_2 emissions of residential buildings in the Netherlands (based on the carbon intensity of the Dutch energy mix).

Figure 3 *Energy consumption and CO_2 emissions ABN AMRO loans compared to average of Dutch residential buildings.*

parameter	unit	average NL	ABN-AMRO	saving	% saving
number of dwellings = households (hh)	hh	1.760	1.760		
Energy performance coëfficiënt (EPC)	-	EI = 1,59	EPC = 0,60		
average user area	m2	102	102		
average loss area	m2	193	193		
average emission CO_2	ton/year	7.614	4.701	2.913	-38%
	kg/hh.year	4.326	2.671	1.655	
	kg/m2.year	42,6	26,3	16,3	

[k] www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energielabel-installatiekeuringen/publicaties/energielabel/methodiek

Project category B
"Green Loans"

B.1. Environmental aspects of solar panels used

Methodology

In the period 1 April 2015 - 29 February 2016 there have been 933 loans for solar panels, building insulation and other sources of renewable energy (wood pellets, seasonal heat storage et cetera) for a total contract amount of € 9,048,553. The outstanding loan amount is somewhat lower, at € 8,272,147.

There is no detailed information available in the ABN AMRO systems on type and technical data of each financed project. Based on samples, we make the assumption that loans with a contracted amount of € 20,000 and higher are expected to include other improvements than only solar panels. Those loans are therefore not included in the impact calculations. Given the wide range of energy efficiency measures, brands, types etc, we are not able to obtain all data for every private loan to calculate a relevant impact score. For that reason we have only included impact reporting for solar pv systems.

The installed pv-power for each of the loans is unknown, as is the actual electricity production. However, we do have information on the loan amount (euro) which can be used to make an estimate of the installed pv-power per loan. Additional to this, we estimate the actual production by using typical yields from scientific literature [I].

Table 1 *Overview of portfolio 'pv loans'*

	Eligible	Included in impact calculations
Number of loans	933	889
Contract amount [euro]	9.048.553	7.873.227
Outstanding amount [euro]	8.272.147	7.255.222

Calculation method

To calculate the total avoided CO_2-emissions, we transfer the loan amount via installed pv-power to estimated production:

loan in euro	&	installation costs in euro/Wp	→ installed pv-power in Wp
installed pv-power in Wp	&	average production in kWh / kWp	→ annual production in kWh
annual production in kWh	&	specific CO_2-emission per kWh	→ total avoided CO_2-emission

Installation costs in euro/Wp

The installed amount of power (watt-peak or Wp) is derived from the installation cost per Wp. This number has changed significantly over the last few years, as can be seen in Table 2 below and varies per year. We have used different sources to provide a reliable estimate of the installation costs per Wp. The figure below shows three sources:

[I] Van Sark et al, "Update of the Dutch pv specific yield for determination of pv contribution to renewable energy production: 25% more energy!", 29th European Photovoltaic Solar Energy Conference and Exhibition, September 2014 http://www.seac.cc/fileadmin/seac/user/doc/7AV.6.43_paper.pdf

- ECN studies on the SDE-subsidies (national subsidies on sustainable energy production units, based on the costs of the generated electricity; updated yearly);
- Market surveys conducted by the 'Solar electricity monitoring foundation' (update irregularly, from 2011 onwards);
- We have checked the above with a sample from the loan data (14 loans per year, 42 in total).

Combining these three sources, an annual amount of installation costs per Wp has been determined. In Annex 2 Table 16 all used documents are listed.

Figure 4 *Historic costs of pv-systems from different sources in euro/Wp, including VAT*

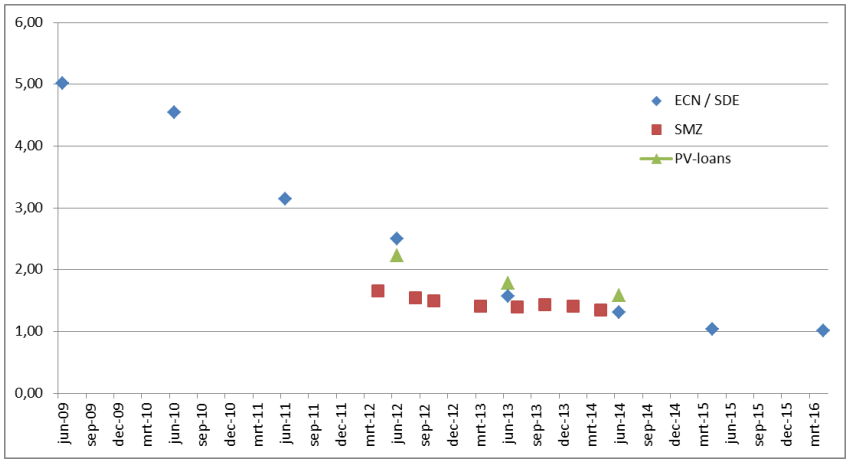


Table 2 *Historic costs of pv-systems used in this assessment in euro/Wp, including VAT*

Calculation values euro/Wp

year	sample	other
-	euro/Wp	euro/Wp
2012	2,33	1,60
2013	1,67	1,40
2014	1,42	1,35
2015	-	1,15
2016	-	1,10

Average production in kWh / kWp

Using the total installed pv-power, it is possible to calculate the annual energy production in kWh using the average production in kWh/kWp. This number has been established at 875 kWh/Wp[m].

Impact indicator 1: Total energy production of solar panels installed

Calculated energy production

As a result, the calculated annual energy production for these systems is 5,900 MWh. In Table 3 below, the results of the calculations are presented.

Over the total expected life span of pv-systems of 25 years, the total predicted electricity production will be 147 GWh.

[m] 29th European Photovoltaic Solar Energy Conference and Exhibition 2014, Update of the Dutch PV specific yield for determination of PV

Impact indicator 2: Avoidance of CO_2 emissions related to these loans

The avoidance of CO_2 emissions is calculated on the basis of the calculated electricity production per year and average carbon intensity of the Dutch energy mix.

There are different values of the carbon intensity in kg per produced kWh of electricity depending on different assumptions in the calculation method. For this assessment we use the same method as ABN AMRO applies in its Annual Integrated Report (which includes Sustainability reporting), on which assurance is provided by KPMG. Figures (also specifically for The Netherlands) are provided by the UK Department for Environment, Food and Rural Affairs[n].

For 2015, the specific CO_2-emission is 0,39895 kg/kWh. This number does not include CO_2-emissions related to transmission and distribution of electricity.

The total avoided CO_2-emissions due to the pv-loans within this bond are 2,383 ton per year. Over the lifespan of 25 years, the avoided CO_2-emissions are approx. 60 thousand ton. The CO_2-emissions of the Dutch electricity grid will likely decline in the future, however, reliable estimates are not available for this effect for the next 25 years. We therefore did not take these developments into consideration in our methodology and model but have used the 2015 numbers to extrapolate avoided CO_2-emissions.

Table 3 *Installed power, electricity production and avoided CO_2 emission of the pv-systems, and cumulative*

Electricity production and avoided CO_2 emission

year	loans - contracted amount			installed power	electricity production	Avoided CO_2
	euro/year install.year	euro cumulative	kWp/year install.year	kWp cumulative	MWh/year cumulative	ton/year cumulative
2012	297.450	297.450	186	186	163	66
2013	238.975	536.425	171	357	312	126
2014	331.733	868.158	246	602	527	213
2015	5.769.209	6.637.367	5.017	5.619	4.917	1.986
2016	1.235.860	7.873.227	1.124	6.743	5.900	2.383
25 years					147.493	59.587

[n] http://www.ukconversionfactorscarbonsmart.co.uk/. Figure for 'overseas electricity The Netherlands'

Project category C
Commercial real estate loans for energy efficient building projects

This category comprises different portfolio's with offices, retail stores and commercially developed retail housing, both renovated and new. The portfolio's contain three existing office buildings in total with a total usable floor area of almost 40,000 m^2, one new office building with a floor area of 2,900 m^2 and two projects with 17,000 m^2 of retail housing. Additionally, eight energy upgrade projects are included, all of them office buildings with a total floor area of 72,000 m^2.

The energy labels of the existing offices are A with an energy index (EI)[o] that varies from 0.78 to 0.91. The new shop and residential buildings will be built in 2015 and 2016 and are assumed to follow the required EPC of 0.4 (dwellings). The new office building is assumed to have a EPC of 0.3, which is much lower than the requirement in the Building Decree (which is 0.8).

C.7. Energy efficiency of buildings

Methodology

New and existing buildings

The CO_2 emissions of the renovated buildings will be calculated according to ISSO 75.3, which is the Dutch calculation method used to determine the energy label for buildings with a commercial building function. The CO_2 emissions of the new buildings and dwellings will be calculated according to NEN 7120, which is the method for calculating the EPC.

The calculated CO_2 emission will compared to the average CO_2 emission of Dutch offices, shops and dwellings. This average will be calculated on the basis of the current distribution of energy labels, the number of energy labels A, the number of energy labels B, et cetera.

For dwellings the average CO_2 emission has been determined in the chapter about 'Project category A', see Figure 3.

Energy upgrades

The CO_2 emissions of the buildings which have undergone an energy upgrade will be calculated according to ISSO 75.3, which is the Dutch calculation method used to determine the energy label for buildings with a non-residential building function. For most of the buildings there is also an estimation of involved consultants of the expected reduction of CO_2-emissions. These estimates have been used to calculate the reduction of the primary energy consumption.

Impact indicator 1: Energy performance

New and existing buildings

The energy consumption of the offices and retail shops is calculated on the basis of the energy-index formula in ISSO 75.3 (calculation method for energy labels for existing commercial buildings). Per

[o] http://wetten.overheid.nl/BWBR0020921/BijlageII/geldigheidsdatum_07-05-2015

building the usable floor area (m^2) and the energy indicator (EI) of the buildings is used to calculate the building related primary energy use for heating, cooling, domestic hot water (dhw), ventilation and lighting. The additional energy consumption for usage of the building like computers, printers, et cetera is not taken into account.

For the new buildings (shops, offices, retail housing) the primary building related energy consumption is calculated using the EPC formula in EPG (energy performance of buildings)[p]. The usable floor area and the required EPC result in the building related primary energy use.

Because the CO_2 emission of 1 MJ of primary energy use for gas is slightly different than that for electricity, an assumption has been made to split the total energy consumption into gas and electricity consumption. The assumptions are that the building related electricity use is 35 kWh/m^2 in offices, 11 kWh/m^2 in retail housing and 90% of the total primary energy in retail shops[q].

Calculated primary energy consumption

The calculated primary energy consumption of the buildings in the portfolio can be found in Table 4.

The energy consumption is given in GJ, MJ/m^2 and in kWh/m^2.

The calculated average primary energy consumption of Dutch buildings can be found in Table 4. For comparison only the energy consumption and CO_2 emission per m^2 usable floor area will be used.

Table 4 *Calculated primary energy consumption for new and existing buildings in the ABN AMRO portfolio's.*

Existing buildings - non-residential

object type	floor area	energy label	EI	EI	prim energy gas	prim energy elektricity	elektricity on meter		primary energy use	
-	m2	-	-	-	GJ	GJ	kWh/m2	kWh/m2	MJ/m2	GJ
offices	12.684	A	0,78	0,78	1.644	4.091	35	126	452	5.736
offices	3.908	A	0,91	0,91	899	1.261	35	154	553	2.160
offices	22.795	A	0,80	0,80	3.120	7.353	35	128	459	10.473
TOTAL	**39.387**		**0,80**	**0,80**	**5.664**	**12.705**		**130**	**466**	**18.369**

New financing - non-residential

object type	floor area	energy label	EPC	EPC * C_epc	prim energy gas	prim energy elektricity	elektricity on meter		primary energy use	
-	m2	-	-	-	GJ	GJ	kWh/m2	kWh/m2	MJ/m2	GJ
Offices	2.873	A	0,30	0,32	0	377	35	36	131	377
TOTAL	**2.873**		**0,30**	**0,32**	**0**	**377**		**36**	**131**	**377**

New financing - residential

object type	floor area	energy label	EPC	EPC * C_epc	prim energy gas	prim energy elektricity	elektricity on meter		primary energy use	
-	m2	-	-	-	GJ	GJ	kWh/m2	kWh/m2	MJ/m2	GJ
Residential	7.380	A	0,40	0,40	1.030	748	11	67	241	1.778
Residential	9.690	A	0,40	0,40	1.444	982	11	70	250	2.427
TOTAL	**17.070**		**0,40**	**0,40**	**2.475**	**1.730**		**68**	**246**	**4.205**

Average energy consumption offices and shops in the Netherlands

The energy label database of RVO provides the number of offices and retail stores per energy label in The Netherlands[r]. The database only includes the buildings which obtained an official energy label. We assume that the energy use of these buildings to be the average energy use of Dutch offices and retail stores. The calculated average energy-index (EI) for offices is 1,32. This EI value is used to calculate the average primary energy consumption and are compared to the EI of buildings in the pool.

The dwellings that are part of this portfolio are relatively small (approx. 45 m2 per dwellings). Using the average energy consumption for Dutch dwellings as described in *Data average dwellings in the Netherlands* would give an overestimation of the energy savings. Instead, we use the more

[p] NEN 7120+C2, Energy performance of buildings -Determination method, 2012

[q] http://www.lente-akkoord.nl/wp-content/uploads/2014/01/WE-rapport-8504-Aanscherping-EPC-2015-eindrapport-versie-20-12-2013-.pdf

[r] RVO database official energy labels, April 2015

conservative average energy-index for Dutch dwellings (1.59 per March 2016), which results in an calculated gas consumption for dwellings of this size of about 1.150 m^3.

Table 5 *Calculated primary energy consumption for average buildings in The Netherlands, same size as the new and existing buildings in the ABN AMRO portfolio's.*

Average existing buildings NL

object type	floor area	energy label	EI	prim energy gas	prim energy elektricity	elektricity on meter		primary energy use	
-	m2		-	GJ	GJ	kWh/m2	kWh/m2	MJ/m2	GJ
offices	10.565	D	1,32	4.693	3.408	35	213	767	8.101
Residential	17.070	C	1,59	15.025	1.730	11	273	982	16.756

Average energy consumption offices and shops in the Netherlands

The table below shows the primary energy consumption of the ABN AMRO portfolio compared to the average for The Netherlands.

Table 6 *Calculated primary energy consumption and savings for new and existing buildings in the ABN AMRO portfolio's.*

Existing buildings - primary energy use		Average NL		Portfolio		Savings		
object type	floor area m2	MJ/m2	GJ	MJ/m2	GJ	MJ/m2	GJ	relative
offices	39.387	767	30.201	466	18.369	300	11.832	-39%
Total Portfolio	39.387		30.201		18.369		11.832	-39%
New financing - primary energy use		**Average NL**		Portfolio		Savings		
object type	floor area m2	MJ/m2	GJ	MJ/m2	GJ	MJ/m2	GJ	relative
offices	2.873	767	2.203	131	377	635	1.825	-83%
retail housing	17.070	982	16.756	246	4.205	735	12.551	-75%
Total Portfolio	19.943		18.959		4.583		14.376	-76%

Energy upgrades

For most of the buildings there is also an estimation of involved consultants of the expected reduction of CO_2-emissions. These estimates have been used to calculate the reduction of the primary energy consumption. The expected reduction in primary energy consumption (average over all buildings) is 31%.

Alternatively, the reduction in primary energy could be calculated using the energy-indices before and after renovation. The overall reduction in EI (and therefore primary energy) would be 39%. We used the more conservative 31% for the impact reporting.

Table 7 *Calculated primary energy consumption for energy upgrades in the ABN AMRO portfolio's (before upgrade).*

Energy efficiency upgrades

object type	floor area	energy label	EI before	EI after	delta EI	prim energy gas	prim energy elektricity	elektricity on meter		primary energy use		expected CO2-reduction
-	m2	-	-	-	-	GJ	GJ	kWh/m2	kWh/m2	MJ/m2	GJ	-
offices	5.696	A	1,37	0,90	34%	2.805	1.837	35	226	815	4.642	30%
offices	16.401	A	1,54	1,10	29%	9.282	5.290	35	247	889	14.573	35%
offices	12.500	A	1,86	0,79	58%	9.451	4.032	35	300	1.079	13.483	30%
offices	13.262	A	1,18	0,89	25%	4.786	4.278	35	190	683	9.064	25%
offices	11.716	A	1,79	0,85	53%	8.400	3.779	35	289	1.040	12.180	35%
offices	4.628	A+++	0,81	0,40	51%	761	1.493	35	135	487	2.254	40%
offices	4.624	A	1,38	1,03	25%	2.345	1.492	35	230	830	3.836	20%
offices	3.231	A	1,59	1,02	36%	2.121	1.042	35	272	979	3.163	32%
TOTAL	**72.058**		**1,50**	**0,90**	**39%**	**39.952**	**23.243**		**244**	**877**	**63.195**	**31%**

Table 8 *Calculated primary energy consumption and savings for energy upgrades in the ABN AMRO portfolio's.*

Energy upgrades - primary energy use		before upgrade		after upgrade		Savings		
object type	floor are m2	MJ/m2	GJ	MJ/m2	GJ	MJ/m2	GJ	relative
offices	72.058	877	63.195	603	43.447	274	19.748	-31%
Total Portfolio	72.058	877	63.195	603	43.447	274	19.748	-31%

Impact indicator 2: CO_2 emission performance

The CO_2-emission performance is calculated on the basis of the calculated primary energy consumption of the buildings and the CO_2-emission indicator 0,04329 kg/$MJ_{primary}$[s] for electricity and 0,506 kg/$MJ_{primary}$ for natural gas.

New and existing buildings

Table 9 Calculated CO_2-emissions per building in the ABN AMRO portfolio's.

Existing buildings - non-residential

object type	floor area	energy label	EI	EI	prim energy gas	prim energy elektricity	CO2	CO2
-	m2	-	-	-	GJ	GJ	kg/m2	ton
offices	12.684	A	0,78	0,78	1.644	4.091	20,5	260
offices	3.908	A	0,91	0,91	899	1.261	25,6	100
offices	22.795	A	0,80	0,80	3.120	7.353	20,9	476
TOTAL	**39.387**		**0,80**	**0,80**	**5.664**	**12.705**	**21,2**	**837**

New financing - non-residential

object type	floor area	energy label	EPC	EPC * C_epc	prim energy gas	prim energy elektricity	CO2	CO2
-	m2	-	-	-	GJ	GJ	kg/m2	ton
Offices	2.873	A	0,30	0,32	0	377	5,7	16
TOTAL	**2.873**		**0,30**	**0,32**	**0**	**377**	**5,7**	**16**

New financing - residential

object type	floor area	energy label	EPC	EPC * C_epc	prim energy gas	prim energy elektricity	CO2	CO2
-	m2	-	-	-	GJ	GJ	kg/m2	ton
Residential	7.380	A	0,40	0,40	1.030	748	11,5	85
Residential	9.690	A	0,40	0,40	1.444	982	11,9	116
TOTAL	**17.070**		**0,40**	**0,40**	**2.475**	**1.730**	**11,7**	**200**

Average existing buildings NL

object type	floor area	energy label	EI	prim energy gas	prim energy elektricity	CO2	CO2
-	m2		-	GJ	GJ	kg/m2	ton
offices	10.565	D	1,32	4.693	3.408	36,4	385
Residential	17.070	C	1,59	15.025	1.730	48,9	835

Table 10 Calculated CO_2-emissions per building in the ABN AMRO portfolio's compared to average for The Netherlands.

Existing buildings - CO2-emissions		**Average NL**		Portfolio		Savings		
object type	floor area		CO2-emissions		CO2-emissions		CO2-emissions	
-	m2	kg/m2	ton	kg/m2	ton	kg/m2	ton	relative
offices	39.387	36,4	1.435	21,2	837	15,2	599	-42%
Total Portfolio	39.387	36,4	1.435	21,2	837	15,2	599	-42%
New financing - CO2-emissions		**Average NL**		Portfolio		Savings		
object type	floor area		CO2-emissions		CO2-emissions		CO2-emissions	
object type	floor are m2	kg/m2	ton	kg/m2	ton	kg/m2	ton	relative
offices	2.873	36,4	105	5,7	16	30,8	88	-84%
retail housing	17.070	48,9	835	11,7	200	37,2	635	-76%
Total Portfolio	19.943	47,1	940	10,9	216	36,3	723	-77%
Existing + new	**59.330**	**40,0**	**2.375**	**17,7**	**1.053**	**22,3**	**1.322**	**-56%**

[s] 0,39895 kg/$kWh_{on\ the\ meter}$; Defra 2016 (0.39895 / 3.6 (MJ/kWh) * 0.39 (efficiency Dutch grid) = 0.04329

Energy upgrades

Table 11 Calculated CO_2-emissions for energy upgrades in the ABN AMRO portfolio's (before upgrade)

Energy efficiency upgrades

object type	floor area	energy label	EI before	EI after	delta EI	prim energy gas	prim energy elektricity	CO2	CO2	expected CO2-reduction
-	m2	-	-	-	-	GJ	GJ	kg/m2	ton	-
offices	5.696	A	1,37	0,90	34%	2.805	1.837	38,9	221	30%
offices	16.401	A	1,54	1,10	29%	9.282	5.290	42,6	699	35%
offices	12.500	A	1,86	0,79	58%	9.451	4.032	52,2	653	30%
offices	13.262	A	1,18	0,89	25%	4.786	4.278	32,2	427	25%
offices	11.716	A	1,79	0,85	53%	8.400	3.779	50,2	589	35%
offices	4.628	A+++	0,81	0,40	51%	761	1.493	22,3	103	40%
offices	4.624	A	1,38	1,03	25%	2.345	1.492	39,6	183	20%
offices	3.231	A	1,59	1,02	36%	2.121	1.042	47,2	152	32%
TOTAL	**72.058**		**1,50**	**0,90**	**39%**	**39.952**	**23.243**	**42,0**	**3.028**	**31%**

Table 12 Calculated CO_2-emissions savings for energy upgrades in the ABN AMRO portfolio's

Energy upgrades - CO2-emissions		before upgrade		after upgrade		Savings		
object type	floor are m2	kg/m2	ton	kg/m2	ton	kg/m2	ton	relative
offices	72.058	42,0	3.028	28,9	2.081	13,1	946	-31%
Total Portfolio	72.058	42,0	3.028	28,9	2.081	13,1	946	-31%

The calculated primary energy use and CO_2-emissions are compared to the average energy consumption and CO_2-emissions of offices, shops and dwellings in the Netherlands.

With the chosen methodology the buildings in the portfolio save about 46,000 GJ primary energy (-41%) and about 2,250 tons of CO_2 emission (-42%) per year compared to the average Dutch buildings with the same commercial function.

The total results and results per building function can be found in Table 13.

Table 13 Calculated primary energy and CO_2 emission savings for the portfolio and the Dutch average.

Portfolio		savings			savings	
object type	floor area	primary energy use			CO2-emissions	
-	m2	kWh/m2	GJ		kg/m2	ton
existing buildings	39.387	83	11.832	-39%	15,2	599	-42%
new financing	19.943	200	14.376	-76%	36,3	723	-77%
energy upgrades	72.058	76	19.748	-31%	13,1	946	-31%
Total Portfolio	131.388	97	45.956	-41%	17,3	2.268	-42%

2 Annexes

EPC-requirements

Figure 5 *Development of EPC-requirements per building type/ function[t]]*

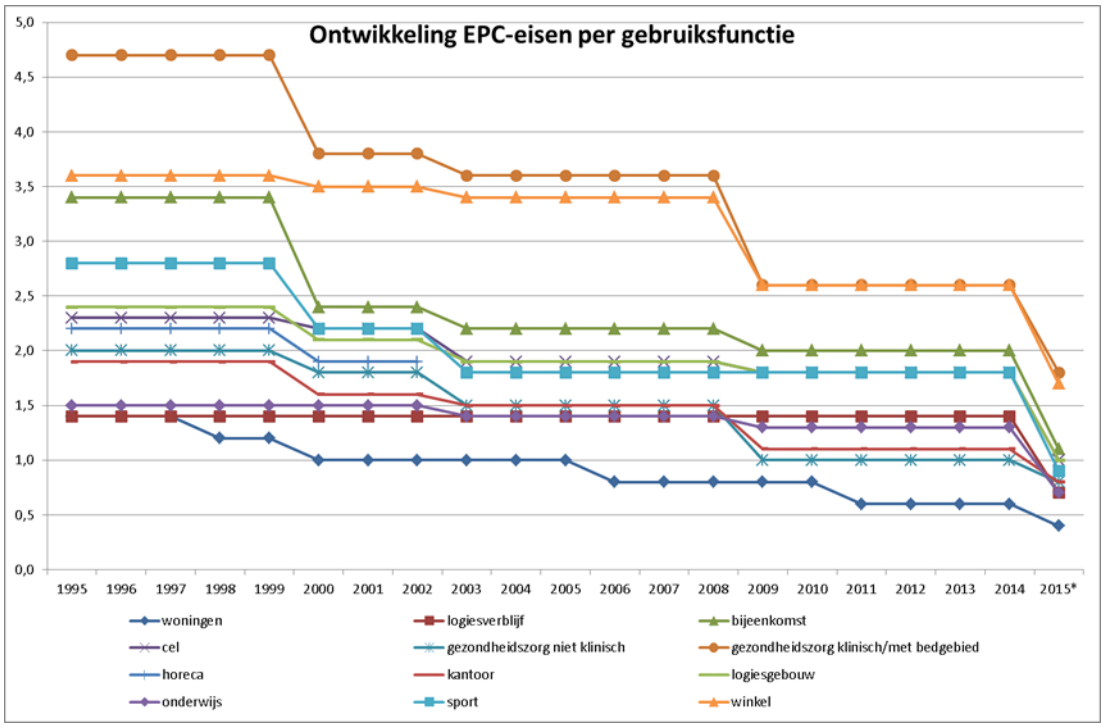


Table 14: *Development of EPC-requirements per use function[t]*

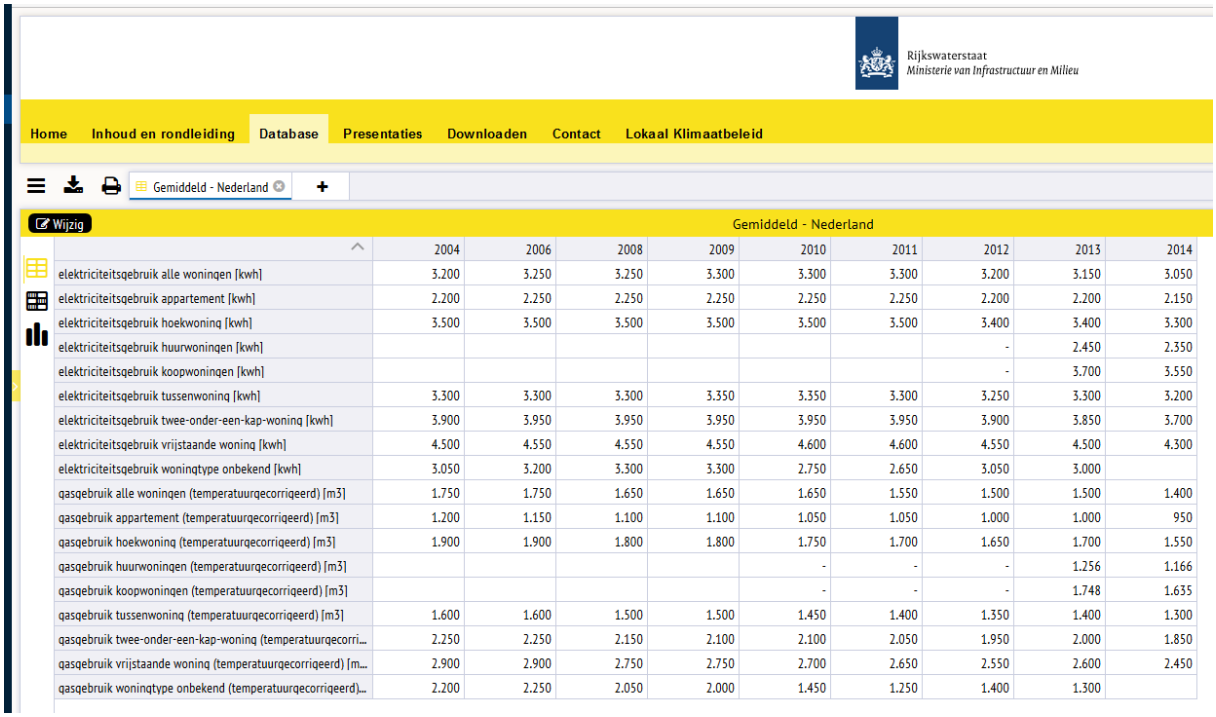
Figures in blue and bold indicate a change in the requirements.

Gebruiksfunctie	Function	1995	1998	2000	2003	2006	2009	2011	2015
Woningen	Residential	1,4	**1,2**	**1,0**	1,0	**0,8**	0,8	**0,6**	**0,4**
Logiesverblijf	Lodging stay	1,4	1,4	1,4	1,4	1,4	1,4	1,4	**0,7**
Bijeenkomst	Gathering	3,4	3,4	**2,4**	**2,2**	2,2	**2,0**	2,0	**1,1**
Cel	Prison Cell	2,3	2,3	**2,2**	**1,9**	1,9	**1,8**	1,8	**1,0**
gezondheidszorg niet klinisch	Non-clinical health care	2,0	2,0	**1,8**	**1,5**	1,5	**1,0**	1,0	**0,8**
gezondheidszorg met bedgebied	Health care	4,7	4,7	**3,8**	**3,6**	3,6	**2,6**	2,6	**1,8**
Horeca	Hospitality	2,2	2,2	**1,9**	-	-	-	-	-
Kantoor	Offices	1,9	1,9	**1,6**	**1,5**	1,5	**1,1**	1,1	**0,8**
Logiesgebouw	Lodging building	2,4	2,4	**2,1**	**1,9**	1,9	**1,8**	1,8	**1,0**
Onderwijs	Education	1,5	1,5	1,5	**1,4**	1,4	**1,3**	1,3	**0,7**
Sport	Sports	2,8	2,8	**2,2**	**1,8**	1,8	1,8	1,8	**0,9**
Winkel	Retail	3,6	3,6	**3,5**	**3,4**	3,4	**2,6**	2,6	**1,7**
Industrie	Industry	-	-	-	-	-	-	-	-

[t] http://www.lente-akkoord.nl/wp-content/uploads/2014/01/WE-rapport-8504-Aanscherping-EPC-2015-eindrapport-versie-20-12-2013-.pdf

Average energy consumption Dutch households

Table 15: Average energy consumption Dutch Households



	2004	2006	2008	2009	2010	2011	2012	2013	2014
elektriciteitsgebruik alle woningen [kwh]	3.200	3.250	3.250	3.300	3.300	3.300	3.200	3.150	3.050
elektriciteitsgebruik appartement [kwh]	2.200	2.250	2.250	2.250	2.250	2.250	2.200	2.200	2.150
elektriciteitsgebruik hoekwoning [kwh]	3.500	3.500	3.500	3.500	3.500	3.500	3.400	3.400	3.300
elektriciteitsgebruik huurwoningen [kwh]							-	2.450	2.350
elektriciteitsgebruik koopwoningen [kwh]							-	3.700	3.550
elektriciteitsgebruik tussenwoning [kwh]	3.300	3.300	3.300	3.350	3.350	3.300	3.250	3.300	3.200
elektriciteitsgebruik twee-onder-een-kap-woning [kwh]	3.900	3.950	3.950	3.950	3.950	3.950	3.900	3.850	3.700
elektriciteitsgebruik vrijstaande woning [kwh]	4.500	4.550	4.550	4.550	4.600	4.600	4.550	4.500	4.300
elektriciteitsgebruik woningtype onbekend [kwh]	3.050	3.200	3.300	3.300	2.750	2.650	3.050	3.000	
gasgebruik alle woningen (temperatuurgecorrigeerd) [m3]	1.750	1.750	1.650	1.650	1.650	1.550	1.500	1.500	1.400
gasgebruik appartement (temperatuurgecorrigeerd) [m3]	1.200	1.150	1.100	1.100	1.050	1.050	1.000	1.000	950
gasgebruik hoekwoning (temperatuurgecorrigeerd) [m3]	1.900	1.900	1.800	1.800	1.750	1.700	1.650	1.700	1.550
gasgebruik huurwoningen (temperatuurgecorrigeerd) [m3]					-	-	-	1.256	1.166
gasgebruik koopwoningen (temperatuurgecorrigeerd) [m3]					-	-	-	1.748	1.635
gasgebruik tussenwoning (temperatuurgecorrigeerd) [m3]	1.600	1.600	1.500	1.500	1.450	1.400	1.350	1.400	1.300
gasgebruik twee-onder-een-kap-woning (temperatuurgecorri...	2.250	2.250	2.150	2.100	2.100	2.050	1.950	2.000	1.850
gasgebruik vrijstaande woning (temperatuurgecorrigeerd) [m...	2.900	2.900	2.750	2.750	2.700	2.650	2.550	2.600	2.450
gasgebruik woningtype onbekend (temperatuurgecorrigeerd)...	2.200	2.250	2.050	2.000	1.450	1.250	1.400	1.300	

Source: www.klimaatmonitor.databank.nl, March 2016

http://www.klimaatmonitor.databank.nl/Jive?sel_guid=b5e93327-de59-4ac8-b56c-1d0e8a6cfd80

Costs of pv-systems

The table below lists all used references to establish an average cost for pv-systems in the period 2011-2016, as used for project category B. Costs are given in euro/Wp.

Table 16: Cost development Solar PV systems

Date	PV-loans	ECN / SDE	SMZ	Remarks	Source
jun-09		5,02		0,6 - 15 kWp	http://www.zonnekrachtcentrales.nl/assets/files/files/SDE%20basisbedragen%20%28advies%29%20%20e08090.pdf
jun-10		4,54		0,6 - 15 kWp	http://www.ecn.nl/docs/library/report/2009/e09058.pdf
jun-11		3,14		1-15 kWp	http://www.ecn.nl/docs/library/report/2010/e10082.pdf
okt-11				average flat/pitched	http://zonnestroom.ophetweb.nu/wp-content/uploads/2013/03/PVmarkt-okt2011.pdf
apr-12			1,65	average flat/pitched	http://zonnestroom.ophetweb.nu/wp-content/uploads/2013/03/PVmarkt-april2012.pdf
jun-12	2,33	2,50		50 a 100 kWp	http://www.ecn.nl/docs/library/report/2011/e11054.pdf
aug-12			1,55	average flat/pitched roof	http://zonnestroom.ophetweb.nu/wp-content/uploads/2013/03/PVmarkt-aug2012.pdf
okt-12			1,50	average flat/pitched roof	http://zonnestroom.ophetweb.nu/wp-content/uploads/2013/04/Marktinventarisatie-oktober-2012.pdf
mrt-13			1,41	average flat/pitched roof	http://www.zonnestroomnl.nl/wp-content/uploads/2013/10/Marktinventarisatie-maart-2013.pdf
jun-13	1,67	1,57		100 kWp	http://www.ecn.nl/docs/library/report/2012/e12038.pdf
jul-13			1,40	average flat/pitched roof	http://www.zonnestroomnl.nl/wp-content/uploads/2013/11/Marktinventarisatie-juli-2013.pdf
okt-13			1,43	average flat/pitched roof	http://www.zonnestroomnl.nl/wp-content/uploads/2014/03/Marktinventarisatie-oktober-2013.pdf
jan-14			1,41	average flat/pitched roof	http://www.zonnestroomnl.nl/wp-content/uploads/2014/07/markt-inventarisatie-jan2014.pdf
apr-14			1,35	average flat/pitched roof	http://www.zonnestroomnl.nl/wp-content/uploads/2014/08/markt-apr2014def.pdf
jun-14	1,42	1,31		100 kWp	https://www.ecn.nl/publicaties/ECN-E--13-050, http://geothermie.nl/fileadmin/user_upload/documents/bestanden/SDE/SDE2014_ECN_Eindavies_31_okt_2013.pdf
apr-15		1,03		100 kWp	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--14-035
apr-16		1,01		250 kWp	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--15-052