W/E rapport

Calculation of the avoided CO_2 emissions financed by the Green Bond Portfolio of ABN AMRO

Update 2019

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Project
W/E 9956

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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 are financed by the outstanding ABN AMRO Green Bond portfolio as per 1 January 2019. This report covers the impact calculations of the current green bond portfolio (consisting of three outstanding green bonds with isin code XS1244060486, XS1422841202 and XS1808739459). The portfolio has a total outstanding of EUR 1.75 billion (raised by three transactions, two of EUR 500mio in size and maturing in 2020 and 2022; a third of EUR 750mio, maturing in 2025).

The process of finding the answers and the assumptions that have been made in that process will be discussed in the 'Methodology' section.

In this report we will calculate the energy use and carbon impact per eligible asset category with the allocation per bond depending on the distribution of allocated assets per 1 January 2019.

We will report on a number of core indicators 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, World bank and others[1].

Results

"The proceeds of the current green bond portfolio are allocated to four project categories of the ABN AMRO Green Bond Framework. For each of these categories, the annual average CO_2 savings (compared to a relevant national benchmark) have been calculated. For all assets within the green bond portfolio combined, the annual savings are about 83,000 tonnes[2] which corresponds to 48 kg per 1,000 euro. For each of the categories, the savings in tonnes per million euro are given in the table 2, table 5 and table 9.

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	25.976.382	100%	100%	20.000.000	12,5	-	-	19.318	16	6.974
Residential Mortgages	EE	1.512.000.000	100%	100%	1.512.000.000	10+	112	158.000	-	-	7.995
Commerical Real Estate	EE	57.000.000	100%	100%	57.000.000	3,85	104	17.327	-	-	817
Off shore wind energy	EE	161.000.000	100%	100%	161.000.000	10+	-	-	185.851	1.184	67.092
Total		**1.755.976.382**	**100%**	**100%**	**1.750.000.000**		**111**	**175.326**	**205.170**	**1200**	**82.878**

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

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

[2] In this report, we use metric tonnes (1,000 kilograms)

2 Project category A Mortgage loans for energy efficient residential buildings

Achieved energy efficiency of buildings

ABN AMRO has selected 3,844 dwellings to be part of the green bond portfolio.

2.1 Methodology

Principle

Within this assessment, we determined the energy usage of the 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[3].

For the Dutch average, we used data from CBS, the Dutch Central Bureau for Statistics (see Table 11).

Energy Performance Coefficient

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[4]"). We refer to Table 10 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[5]. '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%[6] 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[7] 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 0.4 (or lower). The EPC-requirement ≤ 0.4 came

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

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

[5] More information can be found at http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/nieuwbouw/energieprestatie-epc/bepalingsmethode-epc.

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

[7] 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

into effect on 1 January 2015. To make sure that all dwellings within the green bond portfolio meet this requirement and fulfil the criteria of the Dutch Building Decree, only mortgages are selected by ABN AMRO for which the date of the initial offer is minimum 24 months later than the entry date of this EPC requirements.

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 3,844 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[8].

Data average dwellings in the Netherlands

The average energy consumption of *privately owned* dwellings in the Netherlands[9] is about 3,330 kWh of electricity and 1,550 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. 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[10] of Dutch natural gas are 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 comply with the guidelines provided by PCAF[11], specifically their report from November 2018. PCAF refers to www.co2emissiefactoren.nl to determine the specific emission for each energy carrier. For electricity, we used 0.361 kg/kWh. This number includes CO_2-emissions related to transmission and distribution of electricity, but does not include upstream emissions (for winning and transport of fuels).

8 https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/nieuwbouw/energieprestatie-epc/referentiewoningen-epc

9 https://klimaatmonitor.databank.nl/Jive?workspace_guid=d027664f-9cde-4f02-a4be-216499a7e983; screen dump in Annex

10 https://www.rvo.nl/sites/default/files/2017/05/Berekening%20standaard%20CO2-emissiefactoren%20aardgas%20tbv%20nationale%20monitoring%202017%20en%20emissiehandel%202017.pdf

11 PCAF = Platform Carbon Accounting Financials, http://carbonaccountingfinancials.com/

2.2 Impact indicator 1: Energy performance

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

Table 1 Energy consumption ABN AMRO loans compared to average of Dutch residential buildings.

Energy consumption and CO2 emissions ABN AMRO loans compared to average of privately owned residential buildings in the Netherla					
parameter	unit	average NL	ABN-AMRO	saving	% saving
number of dwellings = households (hh)	hh	3.844	3.844		
Energy performance coëfficiënt (EPC)	-		EPC = 0,40		
average user area	m2	102	102		
average loss area	m2	193	193		
average consumption electricity	kWh/hh.year	3.330	3.330		
	kWh/m2	33	33		
average consumption natural gas	m3/hh.year	1.550	381	1.169	-75%
	m3/m2.year	15,26	4	12	
	kWh/m2.year	149	37	112	
average consumption electricity + natural gas	kWh/m2.year	182	69	112	-62%
primary energy use	GJ/year	327.519	169.520	158.000	-48%
	MJ/m2.year	839	434	405	
	kWh/m2.year	233	121	112	

2.3 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). The savings are 5,000 tonnes CO_2 annually.

Table 2 CO_2 emissions ABN AMRO loans compared to average of Dutch residential buildings.

Energy consumption and CO2 emissions ABN AMRO loans compared to average of privately owned residential buildings in the Netherla					
parameter	unit	average NL	ABN-AMRO	saving	% saving
number of dwellings = households (hh)	hh	3.844	3.844		
average emission CO_2	tonnes/year	15.224	7.229	7.995	-53%
	kg/hh.year	3.961	1.881	2.080	
	kg/m2.year	39,0	18,5	20,5	
	kg/keuro			5,29	

3 Project category B1 Renewable Energy - GreenLoans

Environmental aspects of solar panels used

On 1 January 2019, 2,469 loans for solar panels, building insulation and other sources of renewable energy (wood pellets, seasonal heat storage et cetera) have been provided for a total contract amount of € 25,976,382. The outstanding loan amount is somewhat lower, at € 20,018,676.

3.1 Methodology

Principle

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 [12].

Table 3 Overview of portfolio 'pv loans'

	Eligible
Number of loans	2,469
Contract amount [euro]	25,976,382
Outstanding amount [euro]	20,018,676

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 4 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:

- 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);

Combining these three sources, an annual amount of installation costs per Wp has been determined. In Annex 2 Table 12 all used documents are listed.

[12] 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 https://www.seac.cc/wp-content/uploads/2016/11/7AV.6.43_paper.pdf

Figure 1 Historic costs of pv-systems from different sources in euro/Wp, including VAT

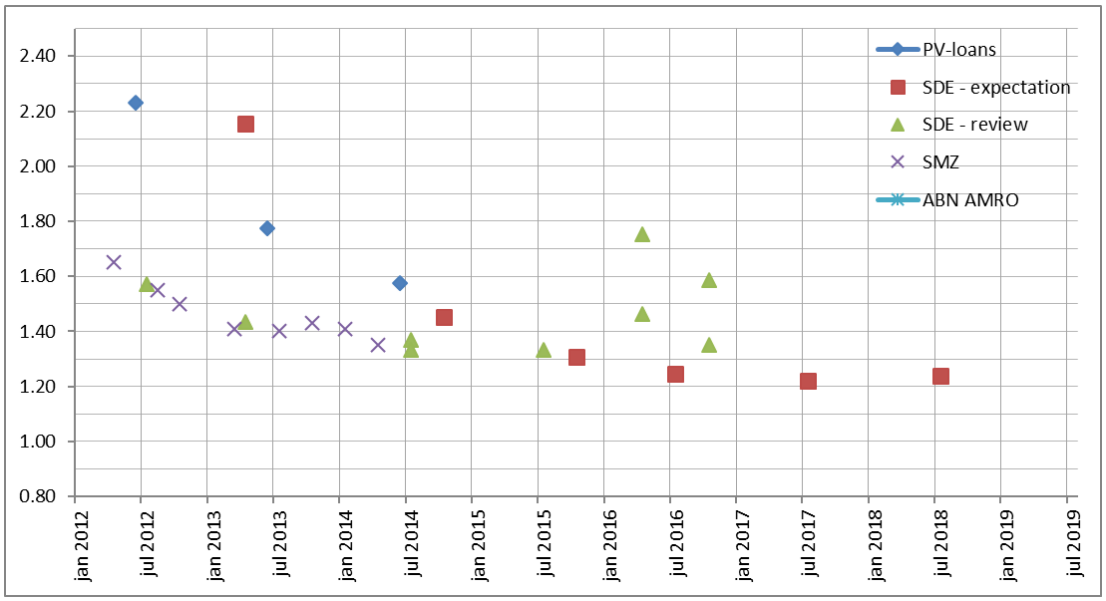

Table 4 Historic costs of pv-systems used in this assessment in euro/Wp, including VAT

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 specific production in kWh/kWp. Because there is no data available on the yield of the included pv-systems, we use the average specific production for all systems in The Netherlands. This number has been established at 875 kWh/Wp[13].

3.2 Impact indicator 1: Total energy production of solar panels installed

As a result, the calculated annual energy production for these systems is 19,318 MWh. In Table 5 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 483 GWh.

3.3 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 emission

[13] 29th European Photovoltaic Solar Energy Conference and Exhibition 2014, Update of the Dutch PV specific yield for determination of PV; https://www.seac.cc/wp-content/uploads/2016/11/7AV.6.43_paper.pdf

factor as outlined in paragraph 2.1 (PCAF 2018 - www.co2emissiefactoren.nl). For 2018, the specific CO_2-emission is 0.361 kg/kWh.

The total avoided CO_2-emissions due to the pv-loans within this bond are 7,000 tonnes per year. Over the lifespan of 25 years, the avoided CO_2-emissions are approx. 193 thousand tonnes. 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 2018 numbers to extrapolate avoided CO_2-emissions.

Table 5 Installed power, electricity production and avoided CO_2 emission of the pv-systems, and cumulative

Electricity production and avoided CO_2 emission

year of installation	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	tonnes/year	tonnes per million euro
2012	1,402,019	1,402,019	876	876	767		
2013	1,418,207	2,820,227	1,013	1,889	1,653		
2014	3,578,789	6,399,016	2,651	4,540	3,973		
2015	6,567,491	12,966,506	5,711	10,251	8,970		
2016	6,623,510	19,590,017	6,021	16,272	14,238		
2017	6,386,365	25,976,382	5,806	22,078	19,318		
2018	0	25,976,382	0	22,078	19,318	6,974	0
25 years					482,962	174,349	

4 Project category B2 Renewable Energy - Offshore wind energy

Environmental aspects of wind turbine generators used

On 1 January 2019, green bond proceeds were allocated to three project finance loans for offshore wind farms with a total outstanding amount of € 161,416,768. Only proceeds of the third green bond issued in 2018 were allocated to these projects.

4.1 Methodology

In accordance to the PCAF[14] guidelines, the P50 value of the expected annual energy yield is taken into account. The P50 value is the predicted annual production for which there is a 50% probability that it will be exceeded in a given year.

The installed power and P50 value for each of the loans is reported in technical due diligence reports, drafted by the Lenders Technical Advisors.

For each of the project, the total construction capital expenditures (CAPEX) is known as well. As ABN AMRO only provides part of the financing, the ABN AMRO share in the CAPEX is used to calculate the energy yield and avoided CO2-emissions to be allocated to the Green Bond.

4.2 Impact indicator 1: Total energy production of wind turbine generators installed

The combined P50-values for the three wind farms is 4,935,000 MWh/a. Over the total expected life span of wind turbine generators of 25 years, the total predicted electricity production will be 123,378 GWh.

The ABN AMRO share in the CAPEX of the project is on average 3.7%, resulting in 186,000 MWh/a to be allocated to these green bonds.

4.3 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 emission factor as outlined in paragraph 2.1 (PCAF 2018 – www.co2emissiefactoren.nl). For 2018, the specific CO_2-emission is 0.361 kg/kWh.

The total avoided CO_2-emissions due to the wind-loans within this bond are 67,092 tonnes per year. Over the lifespan of 25 years, the avoided CO_2-emissions are approx. 1,677 thousand tonnes. 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 2018 numbers to extrapolate avoided CO_2-emissions.

[14] PCAF = Platform Carbon Accounting Financials, http://carbonaccountingfinancials.com/

Table 6 Installed power, electricity production and avoided CO_2 emission of the wind-systems, and cumulative

Electricity production and avoided CO_2 emission			total			ABN AMRO share	
#	nstalled capacity [MW]	electricity production (P50) [GWh/a]	Avoided CO_2 [tonnes/a]	loans - contracted amount [euro]	ABN AMRO share	electricity production (P50) [GWh/a]	Avoided CO2 [tonnes/a]
1	600	2,614	943,510	86,819,417	3.7%	97	34,915
2	332	1,222	440,962	53,056,894	5.5%	67	24,142
3	252	1,100	397,100	21,540,457	2.0%	22	8,035
total	1,184	4,935	1,781,571	161,416,768	3.7%	186	67,092
25 years		123,378	44,539,278			4,646	1,677,310

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

Energy efficiency of buildings

This category comprises different portfolio's with offices, retail stores and commercially developed retail housing, both renovated and new. The portfolios contain existing office buildings, with a total usable floor area of about 12,500 m^2, new shops with a total usable floor area of 5,200 m^2, new office buildings with a total floor area of 16,000 m^2.

5.1 Methodology

Principle for new and existing buildings

For the buildings in this portfolio, actual energy consumption is not available. We therefore use calculated energy consumption based on the energielabel of the buildings.

Calculated CO_2 emission of the buildings within the ABN AMRO portfolio are compared to the average CO_2 emission of Dutch offices, shops and dwellings. Calculations are based on the energy performance of the buildings, which includes the 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[15].

New buildings

For the new buildings (shops, offices, retail housing) the building related primary energy consumption is calculated using the EPC formula in NEN 7120 / EPG (energy performance of buildings)[16]. The usable floor area and the required EPC result in the building related primary energy use.

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 existing buildings with a commercial building function.

For dwellings the average CO_2 emission has been determined in the chapter about 'Project category A', see 2.3.

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 building the usable floor area (m^2) and the energy indicator (EI) of the buildings are 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.

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

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

Average energy consumption offices, shops and dwellings in the Netherlands

The average for offices and shops is 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.

The energy label database of RVO provides the number of offices and retail stores per energy label in The Netherlands[17]. 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 1.29 and for shops 1.04. These EI values are used to calculate the average primary energy consumption and are compared to the EI of buildings in the portfolio.

The calculated average primary energy consumption and resulting CO_2 emission of Dutch buildings can be found in Table 7. For comparison only the energy consumption and CO_2 emission per m^2 usable floor area will be used.

Table 7 Calculated primary energy consumption for average buildings in The Netherlands, same size as the new and existing buildings in the green bond portfolio's.

Average existing buildings NL

object type ABN AMRO	floor area	energy label	EI	primary energy use			CO2	CO2
-	m2		-	kWh/m2	MJ/m2	GJ/m2	kg/m2	tonnes
offices	9,602	D	1.29	209	751	7,211	34.3	329
retail shops	5,205	B	1.04	284	1,024	5,331	41.3	215

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.

[17] RVO database official energy labels, January 2019

5.2 Impact indicator 1: Energy performance

The energy labels of the existing offices are A or A+ with an energy index (EI)[18] at issuance that varies from 0.78 to 0.91. The new offices are assumed to follow the required EPC of 1.1 (office).

Table 8 below shows the primary energy consumption of the ABN AMRO portfolio compared to the average for The Netherlands. The energy consumption is given in GJ, MJ/m^2 and in kWh/m^2.

Table 8 Calculated primary energy consumption for new and existing buildings in the ABN AMRO portfolios.

New financing and existing buildings

object type	floor area	Average NL			Portfolio			Savings			
ABN AMRO	m2	kWh/m2	MJ/m2	GJ	kWh/m2	MJ/m2	GJ	kWh/m2	MJ/m2	GJ/m2	relative
offices	28,807	209	751	21,632	107	384	11,054	102	367	10,578	-49%
retail shops	5,205	284	1,024	5,331	81	291	1,516	204	733	3,815	-72%
retail housing		230	827					230	827		-100%
Total Portfolio	34,012	220	793	26,962	129	466	12,570	118	423	14,393	-53%

Energy upgrades

object type	floor area	before upgrade			after upgrade			Savings			
ABN AMRO	m2	kWh/m2	MJ/m2	GJ	kWh/m2	MJ/m2	GJ	kWh/m2	MJ/m2	GJ/m2	relative
offices	12,483	206	741	9,253	141	506	6,319	65	235	2,934	-32%
retail shops											
retail housing											
Total Portfolio	12,483	206	741	9,253	190	683	6,319	65	235	2,934	-32%
Total Portfolio	46,495	216	779	36,215	113	406	18,889	104	373	17,327	-48%

With the chosen methodology the buildings in the portfolio save about 17,000 GJ primary energy (-48%) per year compared to the average Dutch buildings with the same commercial function.

5.3 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 0.03917 kg/MJ$_{primary}$[19] for electricity and 0.506 kg/MJ$_{primary}$ for natural gas.

Table 9 Calculated CO_2-emissions in the ABN AMRO portfolios compared to average for The Netherlands.

New financing and existing buildings

object type	floor area	Average NL		Portfolio		Savings			Savings
ABN AMRO	m2	kg/m2	tonnes	kg/m2	tonnes	kg/m2	tonnes	relative	tonnes/Meuro
offices	28,807	34.3	988	15.9	459	18.4	529	-54%	12.8
retail shops	5,205	41.3	215	11.7	61	29.5	154	-72%	16.2
retail housing		40.7				40.7		-100%	-
Total Portfolio	34,012	35.4	1,203	15.3	521	20.1	683	-57%	13.5

Energy upgrades

object type	floor area	before upgrade		after upgrade		Savings			Savings
ABN AMRO	m2	kg/m2	tonnes	kg/m2	tonnes	kg/m2	tonnes	relative	tonnes/Meuro
offices	12,483	33.8	422	23.1	288	10.7	134	-32%	18.9
retail shops									-
retail housing									-
Total Portfolio	12,483	33.8	422	23.1	288	10.7	134	-32%	18.9
Total Portfolio	46,495	35.0	1,625	17.4	809	17.6	817	-50%	14.1

With the chosen methodology the buildings in the portfolio save about 817 tonnes of CO_2 emission (-50%) per year compared to the average Dutch buildings with the same commercial function.

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

[19] 0.361 kg/kWh$_{on\ the\ meter}$; www.co2emissiefactoren.nl (0.361 / 3.6 (MJ/kWh) * 0.39 (efficiency Dutch grid) = 0.03917
1.78 kg/m^3 natural gas equals 1.78 / (35.17 MJ/m^3) = 0.506 kg/MJ$_{primary}$

6 Annexes

6.1 EPC-requirements

Figure 2 Development of EPC-requirements per building type/ function[20]

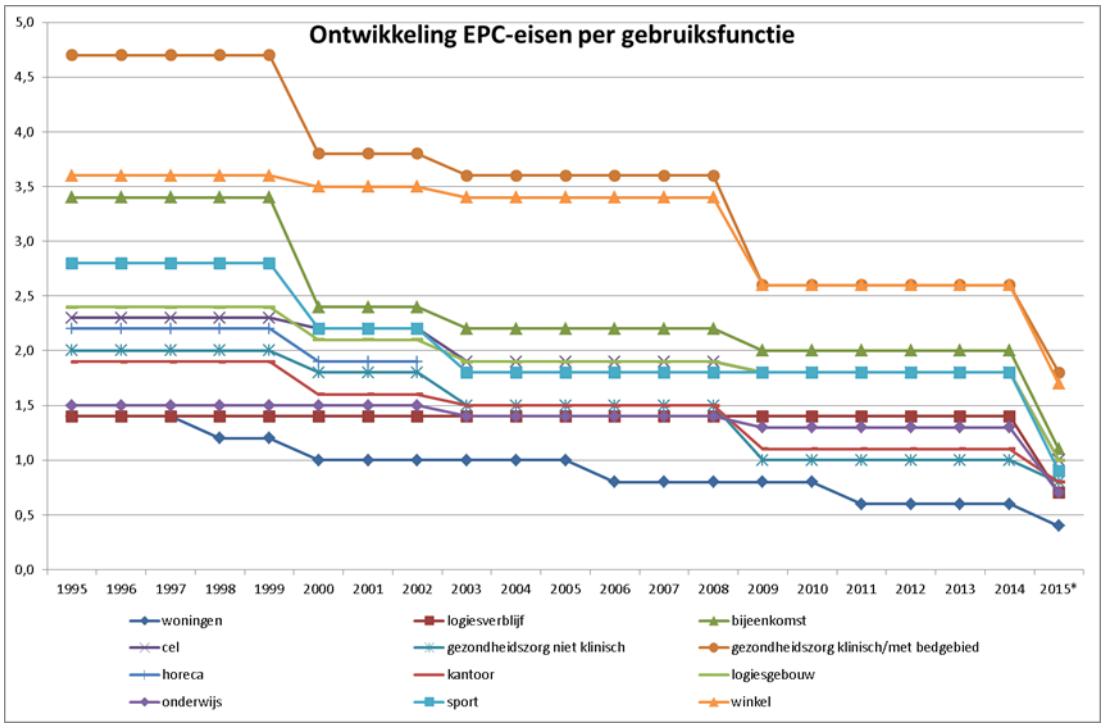

Table 10 Development of EPC-requirements per use function[20]

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	-	-	-	-	-	-	-	-

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

6.2 Average energy consumption Dutch households

Table 11 Average energy consumption Dutch Households

	Gemiddeld - Nederland							
	2010	2011	2012	2013	2014	2015	2016	2017
elektriciteitsgebruik alle woningen (k...	3.300	3.250	3.200	3.150	3.050	2.980	2.910	2.860
elektriciteitsgebruik huurwoningen (...	?	?	?	2.450	2.350	2.300	2.260	2.210
elektriciteitsgebruik koopwoningen (...	?	?	?	3.700	3.550	3.480	3.400	3.330
gasgebruik alle woningen (temperat...	1.620	1.570	1.480	1.450	1.410	1.340	1.320	1.310
gasgebruik huurwoningen (temperat...	?	?	?	1.230	1.180	1.100	1.070	1.070
gasgebruik koopwoningen (temperat...	?	?	?	1.680	1.650	1.580	1.550	1.550

Source: www.klimaatmonitor.databank.nl, June 2019,
https://klimaatmonitor.databank.nl/Jive?workspace_guid=e981aeb0-bd68-4a29-b98e-85fe95863edd

6.3 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 12 Cost development Solar PV systems; prices in euro/Wp, including 21% VAT

Date	PV-loans	SDE - expectation	SDE - review	SMZ	ABN AMRO	Remarks	Source	Link
01-07-2011			2,50			voor 50 a 100 kWp	Eindadvies SDE+ 2012	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--11-054
apr-12				1,65		average flat/pitched roof		http://zonnestroom.ophetweb.nu/wp-content/uploads/2013/03/PVmarkt-april2012.pdf
jun-12	2,23							
01-07-2012			1,57			voor 100 kWp	Eindadvies SDE+ 2013	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--12-038
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-
mrt-13				1,41		average flat/pitched roof		http://www.zonnestroomnl.nl/wp-content/uploads/2013/10/Marktinventarisatie-maart-
01-04-2013		2,15				voor 50 a 100 kWp	Eindadvies SDE+ 2012	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--11-054
01-04-2013			1,43			100 kWp	Eindadvies SDE+ 2014	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--13-050
jun-13	1,78							
jul-13				1,40		average flat/pitched roof		http://www.zonnestroomnl.nl/wp-content/uploads/2013/11/Marktinventarisatie-juli-
okt-13				1,43		average flat/pitched roof		http://www.zonnestroomnl.nl/wp-content/uploads/2014/03/Marktinventarisatie-
jan-14				1,41		average flat/pitched roof		http://www.zonnestroomnl.nl/wp-content/uploads/2014/07/markt-inventarisatie-
apr-14				1,35		average flat/pitched roof		http://www.zonnestroomnl.nl/wp-content/uploads/2014/08/markt-apr2014def.pdf
jun-14	1,58							
01-07-2014			1,37			100 kWp	Eindadvies SDE+ 2015	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--14-035
01-07-2014			1,33			250 kWp	Eindadvies SDE+ 2016	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--15-052
01-10-2014		1,45				100 kWp	Eindadvies SDE+ 2013	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--12-038
01-07-2015			1,33			250 kWp	Eindadvies SDE+ 2017	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--16-040
01-10-2015		1,31				100 kWp	Eindadvies SDE+ 2014	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--13-050
01-04-2016			1,75			15-30 kWp	Kostenonderzoek zonne	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-N--17-012
01-04-2016			1,46			15-1000 kWp	Kostenonderzoek zonne	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-N--17-012
01-07-2016		1,25				100 kWp	Eindadvies SDE+ 2015	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--14-035
01-10-2016			1,59			15-30 kWp	Kostenonderzoek zonne	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-N--17-012
01-10-2016			1,35			15-1000 kWp	Kostenonderzoek zonne	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-N--17-012
01-07-2017		1,22				250 kWp	Eindadvies SDE+ 2016	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--15-052
01-07-2018		1,24				250 kWp	Eindadvies SDE+ 2017	https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-E--16-040
01-07-2019		1,12						