3.14 <NL> The Netherlands

(by EPISCOPE partner DUT)

3.14.1 Current Legal Requirements and Status of National NZEB Definition for Residential Buildings in the Netherlands

In October 2012, the Netherlands sent its first version of the National Plan Nearly Zero-Energy Buildings (‘Nationaal Plan Bijna Energieneutrale Gebouwen’, in short ‘BENG’) to the European Commission and to its national parliament [AgentschapNL, 2013a]. The plan sketches a strategy on how to achieve nearly zero-energy buildings at the end of 2018 (public buildings) and 2020 (other new buildings) respectively.

In the Netherlands, a non-dimensional number is used as an indicator of the building’s energy performance, depending on how the building is used: the ‘energy performance coefficient’, (“energieprestatiecoëfficient” – epc). The epc is determined by dividing the calculated energy requirement of a building by a standardised energy performance, which is based on the heat-transfer surface and the total heated area of the dwelling [Guerra Santin & Itard, 2012]. The calculation of the epc should follow the norm NEN 7120: Energy Performance of buildings – Determination method (“Energieprestatie van gebouwen – Bepalingsmethode”, in short EPG), which also allows using the prenorm NVN 7125 Energy Performance Standard Measures at District Level (“Energieprestatienorm Maatregelen op Gebiedsniveau”, in short EMG). The determination method has the following characteristics:

- the energy use is determined for standard use and climate conditions;
- only the building related energy use is valued in the energy performance;
- if applicable, district related energy use can be valued with the EMG;
- the production of energy can take place inside or outside the building;
- renewable energy sources are valued;
- the net energy use is determined on a yearly basis.

The details of the Dutch calculation method for new buildings can be found in Table 122.

The epc was introduced in 1995 to set a minimal standard regarding the energy efficiency of new buildings (for existing buildings, a different coefficient is used). Over the years the epc standard has been tightened to improve the energetic quality of new buildings. The epc for a nearly zero-energy building is officially stated to be close to 0. In line with EU regulations, this norm will come into force at the end of 2018 for government buildings and at the end of 2020 for other buildings. This level is defined as ‘nearly energy neutral’ (“bijna-energieneutraal”), but the exact value is still unknown.

Regarding renewable energy sources, the principle is that builders are free to choose measures that reduce the demand for energy, use energy from renewable sources, and make effective use of fossil fuels, in order to achieve the required epc. As the requirements for the epc become stricter over time, the percentage of renewable energy will automatically become increasingly important in order to fulfil the requirement. Even so, it will still be compulsory to fulfil the requirements for thermal insulation of the building envelope of new buildings, as stipulated in the Building Decree (“Bouwbesluit”), which is part of the Housing Act (“Woningwet”). As for new and renovated dwellings, this decree prescribes an R_c of at least 3.5 m^2K/W for the building envelope and a U value of 1.65 W/m^2K for windows, doors, etc.

Since 2013, the epc for new and renovated homes should be not more than 0.6. In 2015, a further restriction to a maximum of 0.4 is planned. As stated above, the epc will be further reduced to 0 or nearly 0 to meet European nZEB standards.

Table 122: Current calculation method for new residential buildings referring to the building regulations requirements and special aspects of the (assumed) NZEB definition in the Netherlands

Calculation Method New Building Regulations – (part 1)				
Country	**NL**	The Netherlands	Status	08/2014

National Requirements for New Residential Buildings	Special Aspects with regard to the (assumed) National NZEB Definition
Legislation / Standards NEN 7120: Energy performance of buildings - Determination method **Explanation / Comments**	There is no specific calculation method for nZEBs. The regular calculation method is followed; the outcome of the calculation should meet a certain norm.

Energy Services

x	Heating	x	DHW		Appliances
	Cooling	x	Auxiliary		Other:
x	Ventilation		Lighting		

Explanation / Comments

Calculation Procedure

		Calculation period
x	Calculation of energy need for heating (building)	Month
x	Calculation of delivered energy (system)	Month

Explanation / Comments

Consideration of Special Technologies

Thermal Systems

x	Ventilation system with heat recovery
x	Thermal solar system
	Other special systems:

	On-Site Electricity Production	Feed-in	Self-use[1]	Balance period to determine self-use[1]	Self-use considered for H-C-W-HE[1]
x	On-site CHP	x	x	year	H-W
x	On-site PV	x			
	Other energy generation systems:				

[1] "self use" = parts of the electricity demand of the building is directly covered by the produced electricity; self use considered for "H-C-W-HE": Heating - Cooling - DHW - Household Electricity

Explanation / Comments

Type of Requirements (new buildings)

x	U-values of building elements		Primary energy	
	Heat transfer coefficient by transmission			
	Energy need for heating		Carbon dioxide emissions	
	Delivered energy	x	Other	epc

Explanation / Comments

Special aspects with regard to the (assumed) National NZEB Definition (Type of Requirements): On the basis of NEN 7120, an energy performance coefficient (epc) can be calculated. For nZEBs this coefficient must be equal to or nearly zero. There are no specific nZEB requirements for building elements. The Building Code (based on the Housing Act) prescribes certain U values for all new and renovated buildings, which also apply to nZEBs.

Assessment of energy carriers in the Netherlands

In the Netherlands, almost exclusively gas is used for heating and domestic hot water. To these ends, the use of electricity is mostly auxiliary. The energy factors for each of the energy sources (primary energy value divided by the final energy value) are given in Table 123.

Table 123: Dutch primary energy factors

Label / type of factor	Total Primary Energy Factors Netherlands	Non-Renewable Primary Energy Factor Netherlands
Used for EPC rating	x	x
Used for building regulations requirements		
Label (national language)	Omrekenfactor naar primaire energie van de brandstof	Omrekenfactor naar primaire energie van de brandstof
Description / type of weighting factor	ratio between primary energy use and final energy use for both non-renewable and renewable energy sources, accounting for energy losses during generation and transport	ratio between primary energy use and final energy use for both non-renewable and renewable energy sources, accounting for energy losses during generation and transport
Factor is multiplied by delivered energy based on the	gross calorific value	gross calorific value
Reference	Gas: [TNO, 2008] Electricity: [NEN 2904]	Gas: [TNO, 2008] Electricity: [NEN 2904]
Natural gas	1	1
Heating oil	1	1
Electricity	2.56	2.3

*) Oil is mainly used in local heating, an energy factor of 1 is assumed

3.14.2 Integration of National Requirements for New Buildings and NZEB Standards in the Dutch Residential Building Typology

Classification scheme for the Dutch residential building stock ("Building Type Matrix")

The Dutch building typology is largely based on earlier work carried out by the Netherlands Enterprise Agency ("Rijksdienst voor Ondernemend Nederland" – RVO.nl) and its predecessors AgentschapNL and SenterNovem, which developed a set of reference dwellings that each cover a segment of the housing stock [AgentschapNL, 2011]. As in TABULA, the segments are distinguished according to form (e.g. terraced houses, flats) and building year. The Dutch building typology has been expanded in the EPISCOPE project. Among others, 6 new classes developed later by AgentschapNL [AgentschapNL, 2013b] have been added. The result is presented below.

	Region	Construction Year Class	Additional Classification	SFH Single-Family House	TH Terraced House	MFH Multi-Family House	AB Apartment Block
1	national (nationaal)	… 1964	generic (generiek)	 NL.N.SFH.01.Gen	 NL.N.TH.01.Gen	 NL.N.MFH.01.Gen	 NL.N.AB.01.Gen
2	national (nationaal)	1965 … 1974	generic (generiek)	 NL.N.SFH.02.Gen	 NL.N.TH.02.Gen	 NL.N.MFH.02.Gen	 NL.N.AB.02.Gen
3	national (nationaal)	1975 … 1991	generic (generiek)	 NL.N.SFH.03.Gen	 NL.N.TH.03.Gen	 NL.N.MFH.03.Gen	 NL.N.AB.03.Gen
4	national (nationaal)	1992 … 2005	generic (generiek)	 NL.N.SFH.04.Gen	 NL.N.TH.04.Gen	 NL.N.MFH.04.Gen	 NL.N.AB.04.Gen
5	national (nationaal)	2006 …	generic (generiek)	 NL.N.SFH.05.Gen	 NL.N.TH.05.Gen	 NL.N.MFH.05.Gen	 NL.N.AB.05.Gen

Figure 53: Classification scheme ("Building Type Matrix") of the Dutch residential building typology

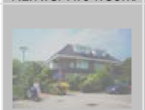
	Region	Construction Year Class	Additional Classification	SFH Single-Family House	TH Terraced House	MFH Multi-Family House	AB Apartment Block
6	national (nationaal)	1965 … 1974	detached (vrijstaand)	 NL.N.SFH.02.Deta			
7	national (nationaal)	1975 … 1991	detached (vrijstaand)	 NL.N.SFH.03.Deta			
8	national (nationaal)	… 1964	semi-detached (twee-onder-één-kap)	 NL.N.SFH.01.Semi			
9	national (nationaal)	1992 … 2005	semi-detached (twee-onder-één-kap)	 NL.N.SFH.04.Semi			
10	national (nationaal)	2006 …	semi-detached (twee-onder-één-kap)	 NL.N.SFH.05.Semi			
11	national (nationaal)	… 1964	terraced house, middle row, built in 1946-1964 (tussenwoning, gebouwd in 1946-1964)		 NL.N.TH.01.Mid1964		
12	national (nationaal)	… 1964	end house, built before 1946 (hoekwoning, gebouwd vóór 1946)		 NL.N.TH.01.End1945		
13	national (nationaal)	… 1964	end house, built in 1946-1964 (hoekwoning, gebouwd in 1946-1964)		 NL.N.TH.01.End1964		
14	national (nationaal)	1965 … 1974	end house (hoekwoning)		 NL.N.TH.02.End		
15	national (nationaal)	1975 … 1991	end house (hoekwoning)		 NL.N.TH.03.End		
16	national (nationaal)	1992 … 2005	end house (hoekwoning)		 NL.N.TH.04.End		
17	national (nationaal)	2006 …	end house (hoekwoning)		 NL.N.TH.05.End		

Figure 54: Classification scheme ("Building Type Matrix") of the Dutch residential building typology, further building types for single family and terraced houses

	Region	Construction Year Class	Additional Classification	SFH Single-Family House	TH Terraced House	MFH Multi-Family House	AB Apartment Block
18	national (nationaal)	… 1964	common staircase and galleries (galerijflat)				 NL.N.AB.01.Gal
19	national (nationaal)	1975 … 1991	common staircase and galleries (galerijflat)				 NL.N.AB.03.Gal
20	national (nationaal)	… 1964	common staircase, no galleries, built before 1946 (portiekflat, gebouwd vóór 1946)				 NL.N.AB.01.Por1945
21	national (nationaal)	1965 … 1974	common staircase, no galleries (portiekflat)				 NL.N.AB.02.Por
22	national (nationaal)	1992 … 2005	common staircase, no galleries (portiekflat)				 NL.N.AB.04.Por
23	national (nationaal)	… 1964	maisonnettes (maisonnetteflat)				 NL.N.AB.01.Mai
24	national (nationaal)	1965 … 1974	maisonnettes (maisonnetteflat)				 NL.N.AB.02.Mai
25	national (nationaal)	1975 … 1991	maisonnettes (maisonnetteflat)				 NL.N.AB.03.Mai
26	national (nationaal)	1992 … 2005	maisonnettes (maisonnetteflat)				 NL.N.AB.04.Mai

Photos: courtesy of AgentschapNL (now RVO.nl)

Figure 55: Classification scheme ("Building Type Matrix") of the Dutch residential building typology, further building types for apartment buildings

The number in the name of the classes refers to the building period. The classes containing "05" in their names present the newest buildings, which have been built after 2005. Some data regarding these classes are presented in Table 124.

Table 124: Exemplary new buildings representing the latest construction year classes (2006 …)

TABULA category		**SFH**	**SFH**	**TH**	**TH**	**MFH**	**AB**
dwelling type		detached house	semi-detached house	terraced house, mid-row	terraced house, end-row	other multi-family buiilding	gallery flat
		 NL.N.SFH.05.Gen	 NL.N.SFH.05.Semi	 NL.N.TH.05.Gen	 NL.N.TH.05.End	 NL.N.MFH.05.Gen	 NL.N.AB.05.Gen
Number of dwellings		1	1	1	1	27	36
Number of full storeys (condi-tioned)		2	2	2	2	4	4
Number of directly at-tached neighbour buildings		0	1	2	1	0	0
Usable floor space	m²	170	148	124	124	2756	2941
TABULA refer-ence area (con-ditioned floor area, internal dimensions)	m²	186	162	137	137	3032	3235
R_c value façade	m^2K/W	3.5	3.5	3.5	3.5	3.5	3.5
R_c value roof	m^2K/W	4.0	4.0	4.0	4.0	4.0	4.0
R_c value ground floor	m^2K/W	3.5	3.5	3.5	3.5	3.5	3.5
U value win-dows	W/m^2K	1.65	1.65	1.65	1.65	1.65	1.65
U value front door	W/m^2K	1.65	1.65	1.65	1.65	1.65	1.65

Source: [AgentschapNL, 2013b]

Building example: variants meeting three energy performance levels for new buildings

The Netherlands has no minimum requirements in terms of U values or R_c values for the existing stock. However, there are such minimum requirements for new buildings. Moreover, these resistance values have to be taken into account in order to attain the prescribed epc levels (0.8 since 2006, 0.6 since 2011).

In Table 125 three levels are presented, namely a minimum requirement, an improved standard and an ambitious or nZEB standard. For the minimum requirement, resistance values have been chosen that, under normal circumstances, would result in an epc of 0.6 or less. The presented U values are the same as in Table 124. These values indicate the existing state, without any refurbishment or other improvements.

The values in the column 'improved standard' denote some minor improvements to the respective homes. Most values are the same as those denoting the existing state, with the exception of the introduction of a low-temperature boiler and balanced ventilation with heat recovery.

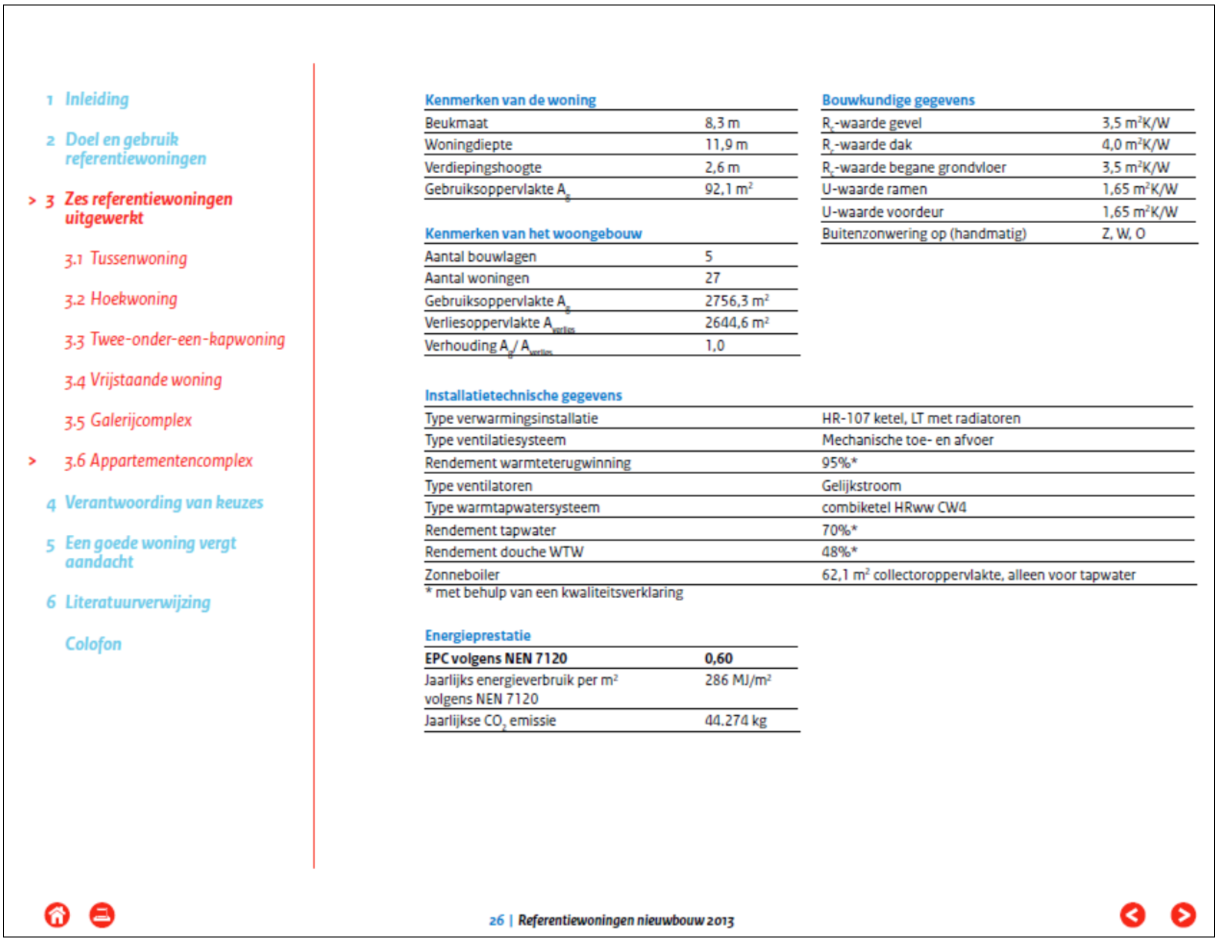
The ambitious or nZEB standard includes extra insulation, plus the introduction of an air to air/water heat pump and balanced ventilation with heat recovery. Regarding the insulation and the installations, we used the following nZEB norms given by [AgentschapNL, 2013b]:

- façade: $R_c > 5.0$ m²K/W
- roof: $R_c > 6.0$ m²K/W
- ground floor: $R_c > 5.0$ m²K/W
- windows: U = 1.00 W/m²K
- front door: U = 1.4 W/m²K
- low-temperature (35-45ºC), high-efficiency boiler (HR107)
- balanced ventilation, 95% heat recovery
- solar boiler, including 5.5 m² of solar cells
- entire south-oriented roof used for PV panels

Table 125 presents the resulting insulation and system data for one of the six newest classes, namely a multi-family building not being a gallery flat. The corresponding page in the national brochure concerning the building typology is shown in Figure 56; the results of some calculations with the TABULA program for this building type are included in Table 126.

Table 125: Exemplary multi-family house (MFH) – definition of variants

Energy Performance Level		**Minimum Requirement**	**Improved Standard**	**Ambitious Standard / NZEB**
U values				
Roof	W/(m²K)	0.25	0.25	0.17
Wall	W/(m²K)	0.29	0.29	0.20
Window	W/(m²K)	1.65	1.65	1.00
Door	W/(m²K)	1.65	1.65	1.40
Floor	W/(m²K)	0.29	0.29	0.20
Heat Supply System				
Heat generator		high efficiency boiler, high tempera-ture	High efficiency boiler, low tempera-ture	Air to air/water heat pump
Ventilation system		exhaust, direct current	balanced, direct current	balanced, direct current
Thermal solar boiler		no	no	yes



Kenmerken van de woning	
Beukmaat	8,3 m
Woningdiepte	11,9 m
Verdiepingshoogte	2,6 m
Gebruiksoppervlakte A_g	92,1 m²

Bouwkundige gegevens	
R_c-waarde gevel	3,5 m²K/W
R_c-waarde dak	4,0 m²K/W
R_c-waarde begane grondvloer	3,5 m²K/W
U-waarde ramen	1,65 m²K/W
U-waarde voordeur	1,65 m²K/W
Buitenzonwering op (handmatig)	Z, W, O

Kenmerken van het woongebouw	
Aantal bouwlagen	5
Aantal woningen	27
Gebruiksoppervlakte A_g	2756,3 m²
Verliesoppervlakte $A_{verlies}$	2644,6 m²
Verhouding A_g / $A_{verlies}$	1,0

Installatietechnische gegevens	
Type verwarmingsinstallatie	HR-107 ketel, LT met radiatoren
Type ventilatiesysteem	Mechanische toe- en afvoer
Rendement warmteterugwinning	95%*
Type ventilatoren	Gelijkstroom
Type warmtapwatersysteem	combiketel HRww CW4
Rendement tapwater	70%*
Rendement douche WTW	48%*
Zonneboiler	62,1 m² collectoroppervlakte, alleen voor tapwater

* met behulp van een kwaliteitsverklaring

Energieprestatie	
EPC volgens NEN 7120	**0,60**
Jaarlijks energieverbruik per m² volgens NEN 7120	286 MJ/m²
Jaarlijkse CO_2 emissie	44.274 kg

26 | Referentiewoningen nieuwbouw 2013

Source: [AgentschapNL, 2013b]

Figure 56: “Building Display Sheet” of the exemplary multi-family building

Table 126: Exemplary MFH – Results of the energy balance calculation; Procedure: TABULA method

Variant N°		**001**	**002**	**003**
Label of the variant triplet		NL.N.MFH.05.Gen.ReEx.001 (multifamily building other than gallery flat, built after 2005)		
Variation level		Minimum Requirement	Improved Standard	Ambitious Standard / NZEB
TABULA reference area	m²	3032	3032	3032
Energy need for heating	kWh/(m²a)	57	57	28
Delivered energy	kWh/(m²a)	66	31	13
Fossil fuels	kWh/(m²a)	66	31	0
Renewable fuels	kWh/(m²a)	0	0	0
Electricity	kWh/(m²a)	0	0	13
Auxiliary energy	kWh/(m²a)	5	7	7

TABULA calculation results for all exemplary buildings

Table 127 shows the results of the TABULA calculation procedure (standard calculation, not adapted) for all six exemplary buildings.

Table 127: Exemplary new buildings – Results of the TABULA calculation procedure (standard boundary conditions)

Building	Var. N°	Performance Level	h_Transmission W/(m²K)	q_h_nd kWh/(m²a)	q_ve_rec_h_usable kWh/(m²a)	q_h_nd_net kWh/(m²a)	q_g_h_out kWh/(m²a)	q_w_nd kWh/(m²a)	q_g_w_out kWh/(m²a)	q_del_sum_gas kWh/(m²a)	q_del_sum_oil kWh/(m²a)	q_del_sum_coal kWh/(m²a)	q_del_sum_bio kWh/(m²a)	q_del_sum_el kWh/(m²a)	q_del_sum_dh kWh/(m²a)	q_del_sum_other kWh/(m²a)	q_exp_sum_el kWh/(m²a)
SFH (detached)	01	Minimum Requirement	0.83	72	0	72	77	10	14	97	0	0	0	0	0	0	0
	02	Improved Standard	0.83	72	33	39	45	10	14	62	0	0	0	0	0	0	0
NL.N.SFH.05.Gen	03	Ambitious Standard / NZEB	0.55	41	22	19	24	10	24	0	0	0	0	15	0	0	0
SFH (semi-detached)	01	Minimum Requirement	0.62	66	0	66	71	10	14	91	0	0	0	0	0	0	0
	02	Improved Standard	0.62	66	34	32	38	10	14	55	0	0	0	0	0	0	0
NL.N.SFH.05.Semi	03	Ambitious Standard / NZEB	0.42	37	22	15	20	10	24	0	0	0	0	13	0	0	0
TH (mid-row)	01	Minimum Requirement	0.56	61	0	61	66	10	14	86	0	0	0	0	0	0	0
	02	Improved Standard	0.56	61	33	27	33	10	14	50	0	0	0	0	0	0	0
NL.N.TH.05.Gen	03	Ambitious Standard / NZEB	0.36	33	22	11	16	10	24	0	0	0	0	12	0	0	0
TH (end-row)	01	Minimum Requirement	0.69	67	0	67	72	10	14	92	0	0	0	0	0	0	0
	02	Improved Standard	0.69	67	33	34	39	10	14	57	0	0	0	0	0	0	0
NL.N.TH.05.End	03	Ambitious Standard / NZEB	0.46	38	22	15	21	10	24	0	0	0	0	14	0	0	0
AB	01	Minimum Requirement	0.53	59	0	59	64	15	19	89	0	0	0	0	0	0	0
	02	Improved Standard	0.53	59	33	26	31	15	19	54	0	0	0	0	0	0	0
NL.N.AB.05.Gen	03	Ambitious Standard / NZEB	0.35	30	21	10	15	15	29	0	0	0	0	13	0	0	0
MFH	01	Minimum Requirement	0.52	57	0	57	62	15	19	87	0	0	0	0	0	0	0
	02	Improved Standard	0.52	57	33	24	30	15	19	52	0	0	0	0	0	0	0
NL.N.MFH.05.Gen	03	Ambitious Standard / NZEB	0.33	28	20	8	13	15	29	0	0	0	0	13	0	0	0

Explanation of Quantities (TABULA Datafields)

h_Transmission	W/(m²K)	floor area related heat transfer coefficient by transmission / indicator for energy quality of building envelope (compactness + insulation)
q_h_nd	kWh/(m²a)	energy need for heating
q_ve_rec_h_usable	kWh/(m²a)	usable contribution of ventilation heat recovery
q_h_nd_net	kWh/(m²a)	net energy need for heating (q_h_nd - q_ve_rec_h_usable)
q_g_h_out	kWh/(m²a)	generated heat heating system (net energy need + storage losses + distribution losses)
q_w_nd	kWh/(m²a)	net energy need domestic hot water
q_g_w_out	kWh/(m²a)	generated heat dhw (net energy need + storage losses + distribution losses)
q_del_sum_gas, ..._oil, ..._coal, ... _bio, ..., _el, ... _dh, ... _other, ..._el	kWh/(m²a)	sum delivered energy, energy carrier gas, oil, coal, biomass, electricity, district heating, other energy carriers
q_exp_sum_el	kWh/(m²a)	sum produced electricity (negative value)

3.14.3 Sources / References Netherlands

The references used in this subchapter are listed in Table 128.

Table 128: Sources / References for the Netherlands

Reference shortcut	Concrete reference (in respective language)	Short description (in English)
[AgentschapNL, 2011]	AgentschapNL (2011), Voorbeeldwoningen 2011, http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/woningbouw/particuliere-woningen/voorbeeldwoningen	presents a building typology, which is further developed in EPISCOPE
[AgentschapNL, 2013a]	AgentschapNL (2013), Infoblad energieneutraal bouwen – definitie en ambities, http://www.agentschapnl.nl/sites/default/files/Infoblad%20Energieneutraal%20bouwen%20Definitie%20en%20ambitie%20april%202013.pdf	brochure of the Dutch national government regard-ing the definition of nZEB
[AgentschapNL, 2013b]	AgentschapNL (2013), Referentiewoningen nieuw-bouw 2013, http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energieprestatie-nieuwbouw-epn/ontwerpen/referentiewoningen-nieuwbouw	presents 6 reference dwellings built after 2005, which form an extension of the Dutch building typology
[Guerra Santin & Itard, 2012]	Guerra Santin, O. / Itard, L. (2012), The effect of energy performance regulations on energy con-sumption, Energy Efficiency (2012) 5:269–282	article about the impact of the epc standard on the energy performance of dwellings
[NEN 2904]	NEN 2904:2004 - Energieprestatie van utiliteitsgebouwen - Bepalingsmethode	describes (among others) the calculation method of the epc for utility buildings. It contains the ratio of primary and final energy use for electricity, which is not only valid for utility buildings, but for all buildings.
[NEN 7120]	NEN 7120+C2:2012 nl - Energieprestatie van gebouwen - Bepalingsmethode	describes (among others) the calculation method of the epc for new buildings (and also the Energy Index for existing buildings)
[NVN 7125]	NVN 7125:2011 n - Energieprestatienorm voor maatregelen op gebiedsniveau (EMG) - Bepalingsmethode	describes a method for including the energy infra-structure at the district level in the calculation of the energy performance of a building. This can be seen as an addition on NEN 7120.
[TNO 2008]	TNO Built Environment and Geosciences (2008), Information on Standardization: Numerical indica-tor for the energy performance based on primary energy use and CO2 emissions - Procedures according to CEN standard EN 15603	contains the ratio of primary and final energy use for gas