IEA HPT Annex 50

Heat Pumping Systems for Heating and Domestic Hot Water in Multi Family Buildings

Market Overview

Country Report Netherlands

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6-11-2017

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the Netherlands Enterprise Agency (RVO)

Contents

Key Facts in the Netherlands

(source: EHPA)

Heat pump benefits

	2015	Potential*
Sales	8k	226k
Stock	76k	2.6m
Renewable energy produced	2.3 TWh	79.2 TWh
CO2 emissions saved	0.59 Mt	20.7 Mt
Final energy saved	2.9 TWh	99.9 TWh
Full time jobs provided	654 Jobs	22 853 Jobs

Table 5.13-1: Heat pump benefits, 2015 vs. potential. The potential is calculated based on the method presented in chapter 4.6

Key facts

Capital	Amsterdam	
GDP per capita	35 900 €	
		rank

Housing

Dwelling stock by category		
Total	7 459 694	% of tot:
One	4 726 666	63.4%
Two	250 607	3.4%
Multi	2 062 066	27.6%
Non residential	105 568	1.4%
Average energy consumption per m²	194 kWh/m²	
Space heating	123 kWh/m²	63.2%
Water heating	27.6 kWh/m²	14.2%
Other	43.7 kWh/m²	22.5%
Growth of new building permits	50.3%	

Renewable energy

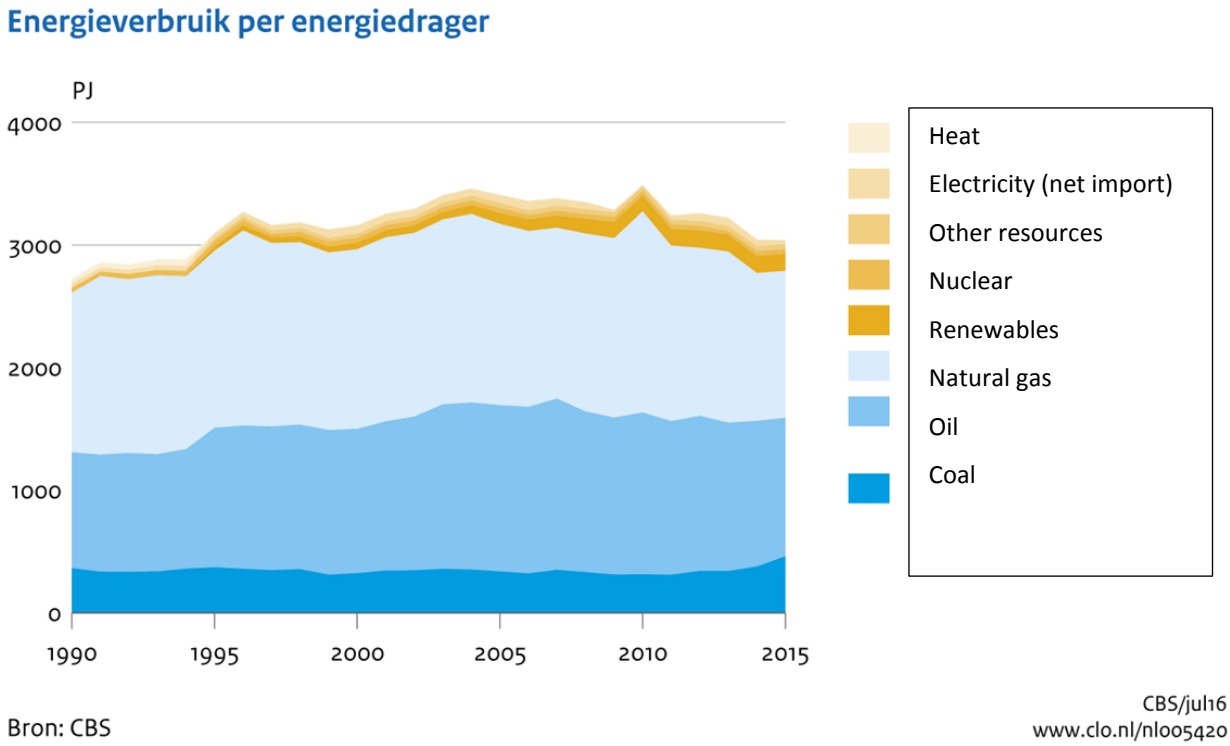
Share of renewable energy of total consumption	5.5%
EU 2020 target for the share of renewable energy	14%
National emission factor of electricity	404 g/kWh

Energy consumption

Dwellings by energy source used for space heating		
Gas	5 976 240	85.5%
Oil	8 860	0.13%
Biomass	163 230	2.3%
District heating	795 470	11.4%
Electricity	43 030	0.62%
Coal	-	-
Energy prices		
Electricity	0.18 €/kWh	
Gas	0.1 €/kWh	
Heating oil	0.14 €/kWh	
District heating	-	
Pellets	-	

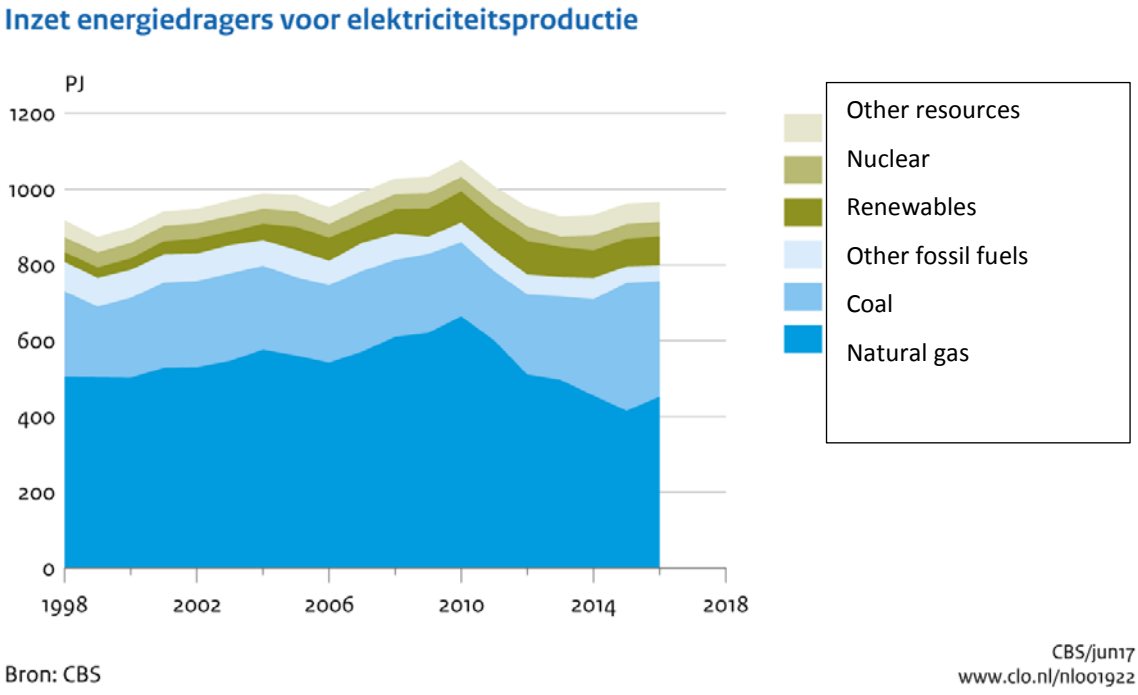
Table 5.13-2: Factsheet Netherlands

1 Dutch Energy Demand

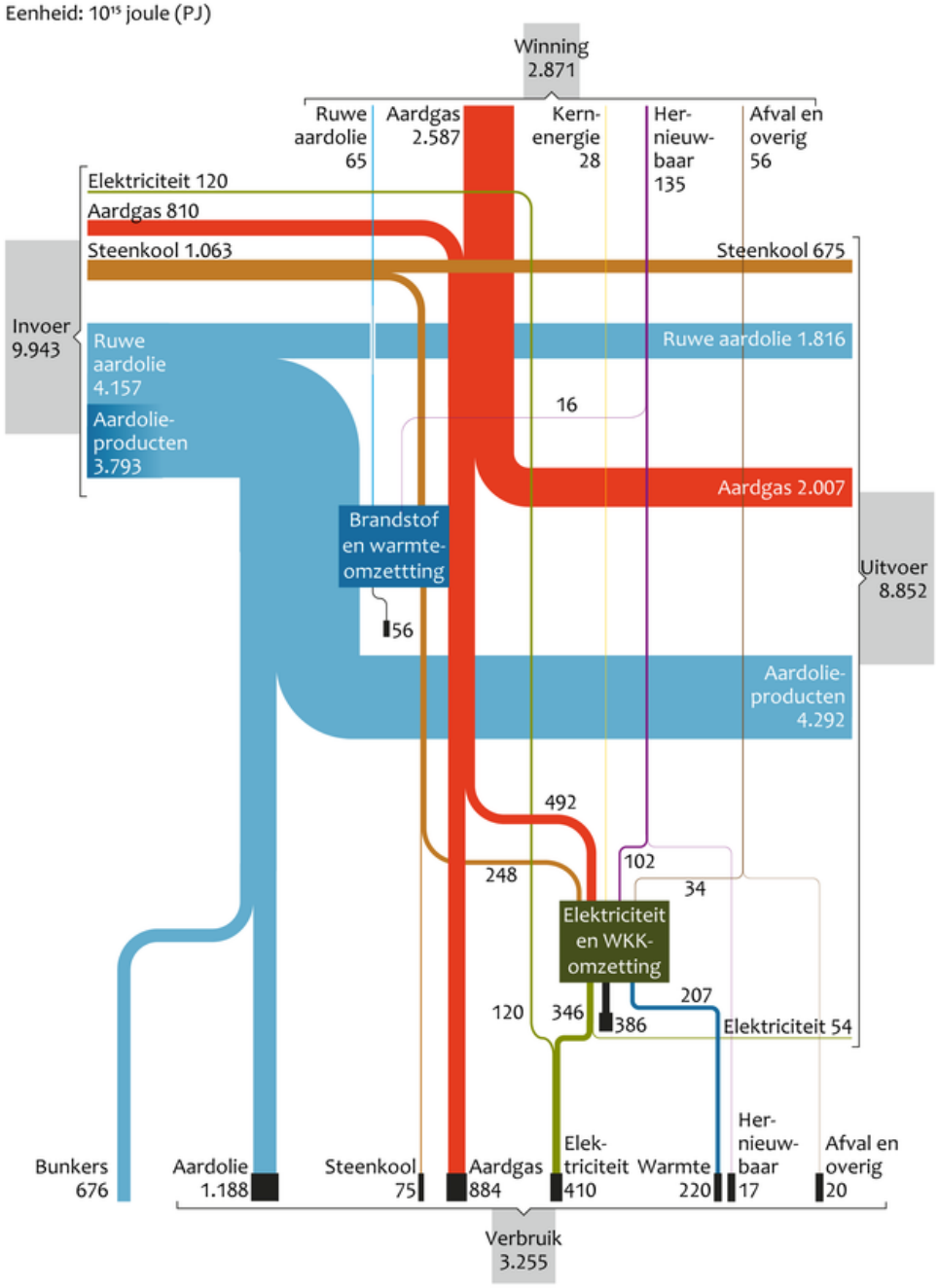


Energy use per energy carrier(source CBS)

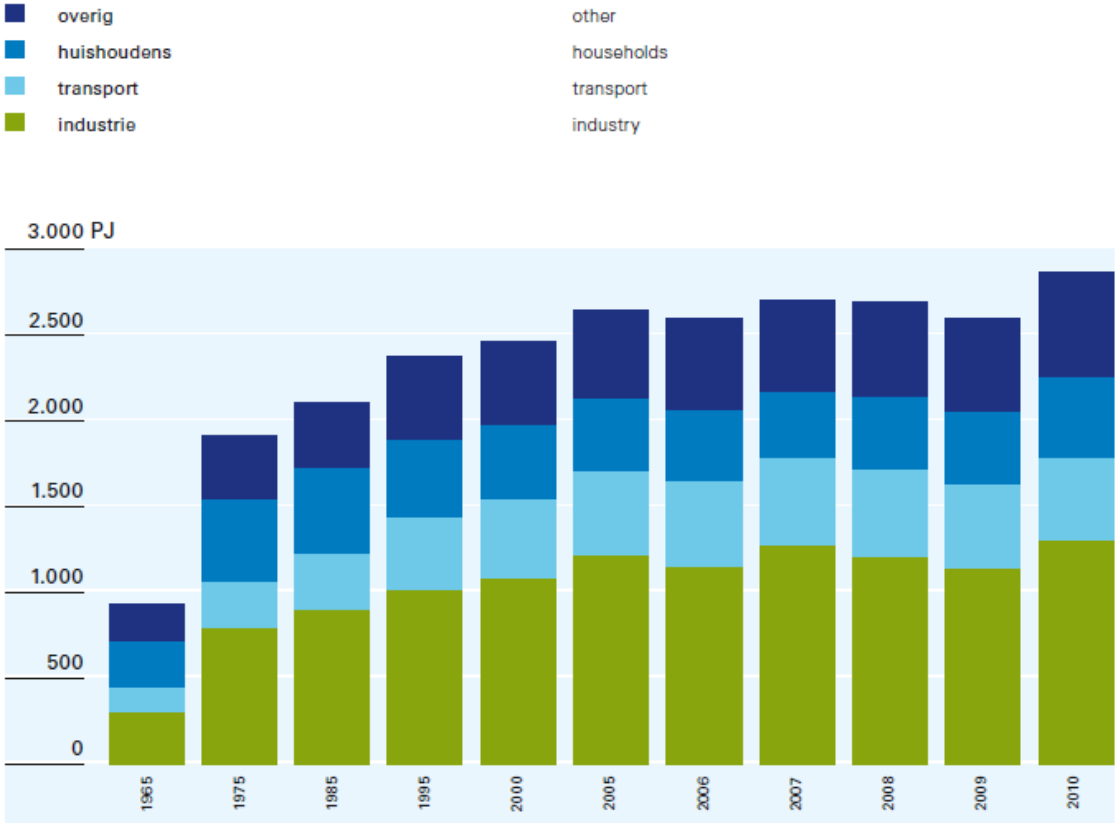
Total energy consumption per capita in kilogram oil-equivalent (kg-oe)



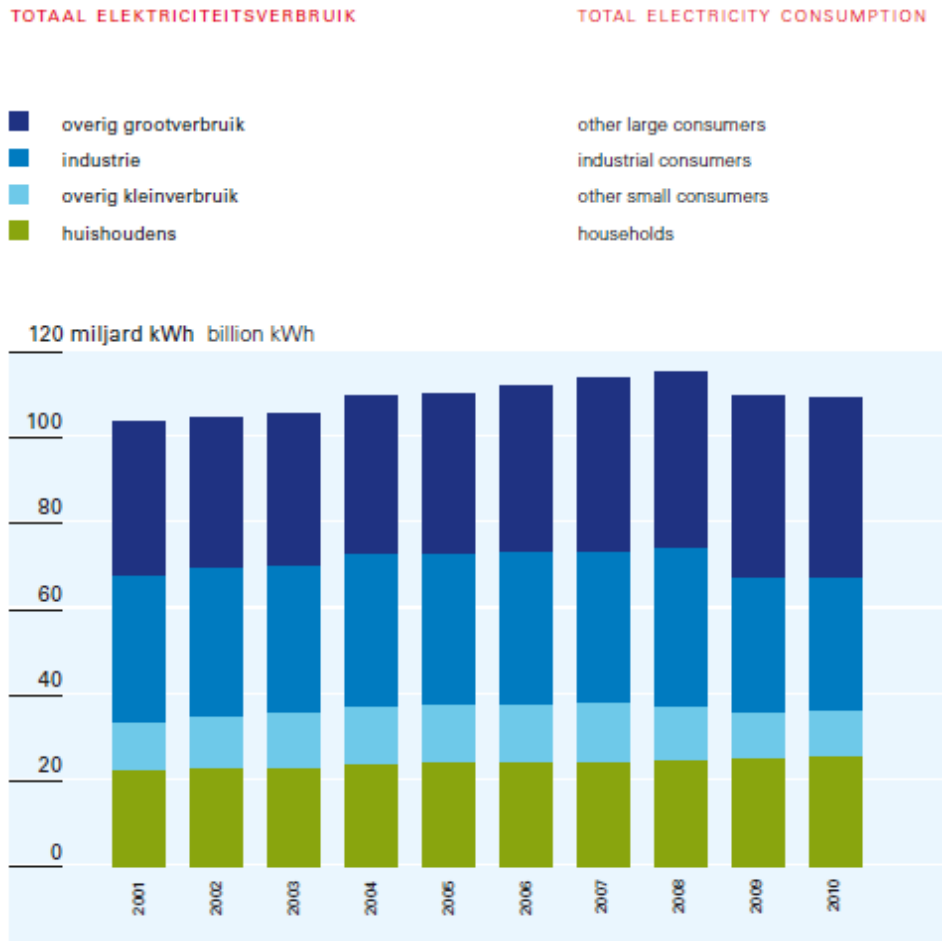
Energy Carriers for Production of Electricity (source: CBS)



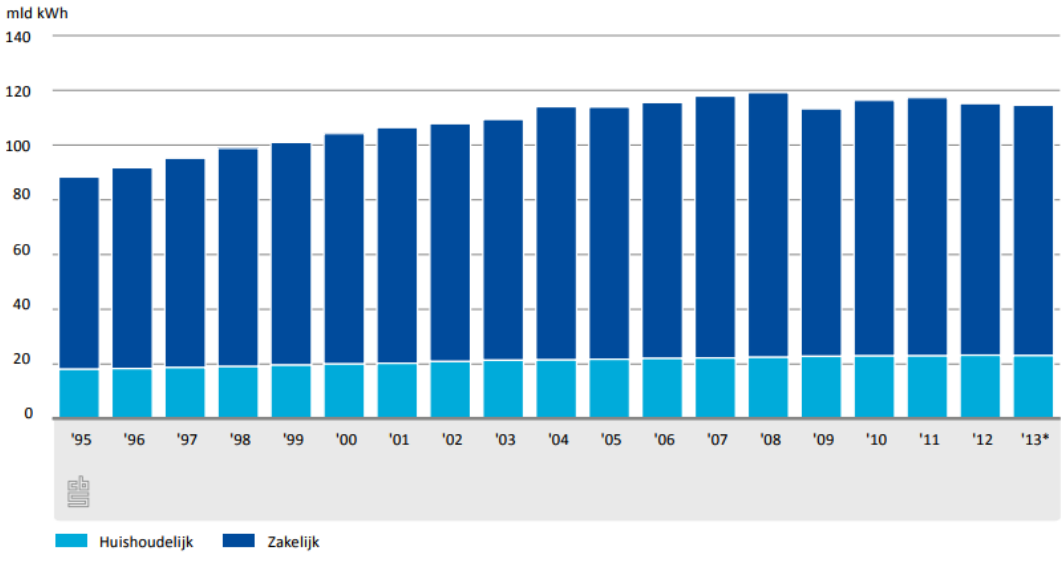
Dutch Energy Flows (2013) in PJ



Breakdown of total energy use in NL [Energie in Nederland 2011, Energie Nederland/Netbeheer Nederland. 2011]



Total Electricity Consumption [Energie in Nederland 2011, Energie Nederland/Netbeheer Nederland. 2011]



Dutch electricity consumption in billions of kWh [source: CBS 2015]
The average use of electricity per household is approx. 3000 kWh/year and decreasing

	2000	2015	Eenheid	Verandering 2015/2000
Number of inhabitants on January 1st	15.863.950	16.900.726		6,5%
Number of households on January 1st	6.801.000	7.665.000		12,7%
Average number of persons per household	2,3	2,2		-5,5%
Average use of natural gas per household	1900	1432	m^3	-24,6%
Average use of electricity per household	3103	2966	kWh	-4,4%
Average use of car fuel per household	1067	964	liter benzine/diesel/LPG	-9,7%

Energy characteristics households

Source: Energy trends – [ECN, Energie-Nederland, Netbeheer Nederland - 2016]

2 Policy framework

2.1 Building regulations

For each new building (domestic or commercial) an energy performance directive applies. Energy performance demands have been sharpened and will lead to (n)ZEB's within a few years. The new regulations apply to three important factors of the building. For domestic buildings the following limits are mandatory, starting in 2021:

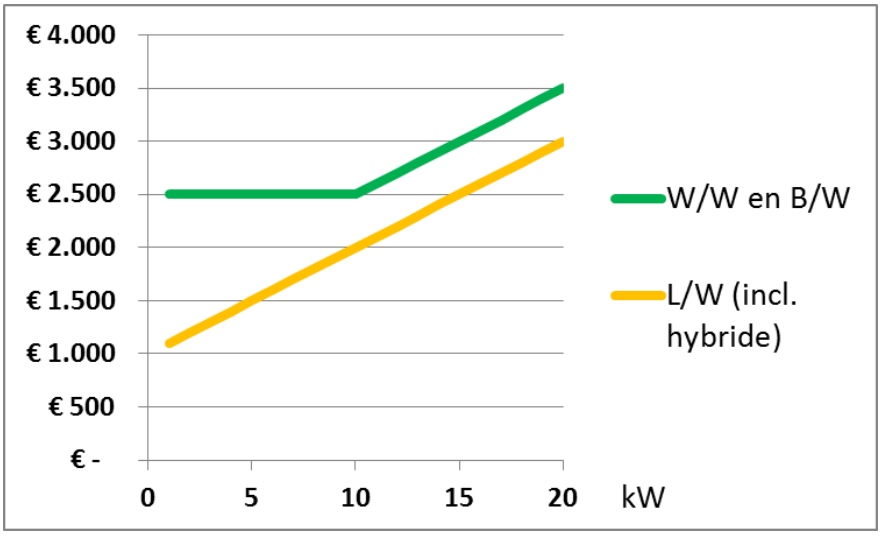
- Space Heating demand: max 25 kWh/m2 per year
- Primary Energy use: max 25 kWh/m2 per year (including DHW)
- Renewable energy contribution: min 50%

2.2 Energy Taxes

Energy taxes have been increased over the years. In 2015 the energy tax on natural gas was € 0,19 per m3 (9,78 kWh/m3) and on electricity € 0,12 per kWh. This enormous imbalance was slightly corrected on 1-1-2016 by the government increasing the energy tax on gas to 0,25 €/m3 and decreasing the ET on electricity to 0,10 €/kWh (all values excl. VAT). A smaller correction is expected again on 1-1-2018. In this the government has a powerful tool stimulating heat pumps

2.3 Subsidy

Also on 1-1-2016 the government started a subsidy regulation for the initial costs of renewable energy applications concerning heat pumps, biomass-boilers and solar thermal energy (large scale renewables like wind turbines at sea are stimulated otherwise). For heat pumps the following subsidy applies (linear from 10-70 kW); (L/W stands for A/W):



2.4 Protecting the underground

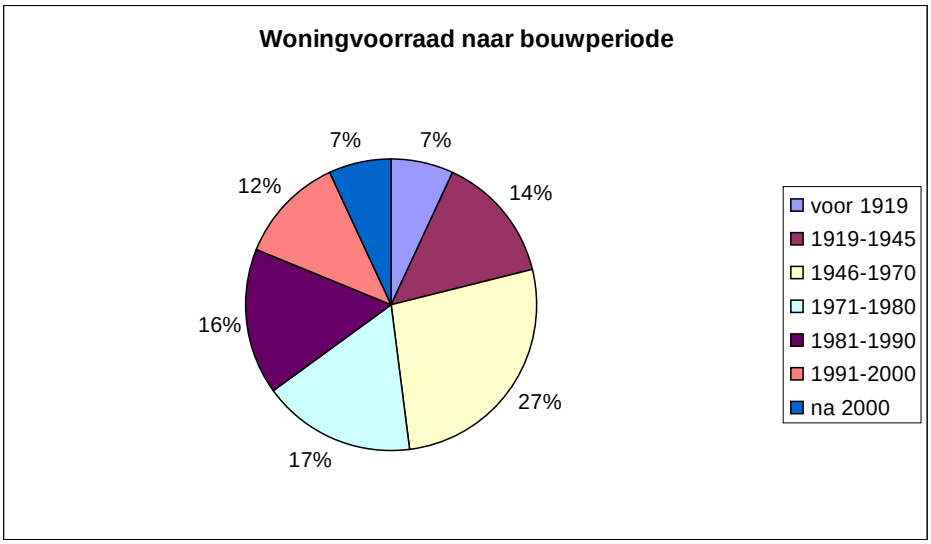
Very strict regulations apply for using the underground as energy storage (ATES and BTES)

2.5 Quality system for A/W heat pumps

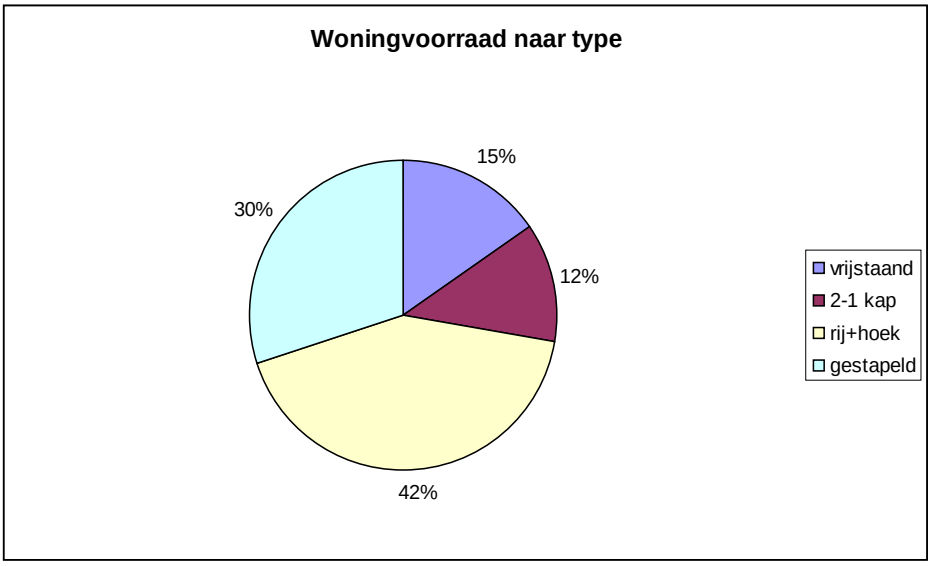
The DHPA is developing a training programme for installers.

3 Building stock characteristics

Historical overview of houses built and owned by housing corporations.
Total number of MFB-apartments in 1989: 960.000



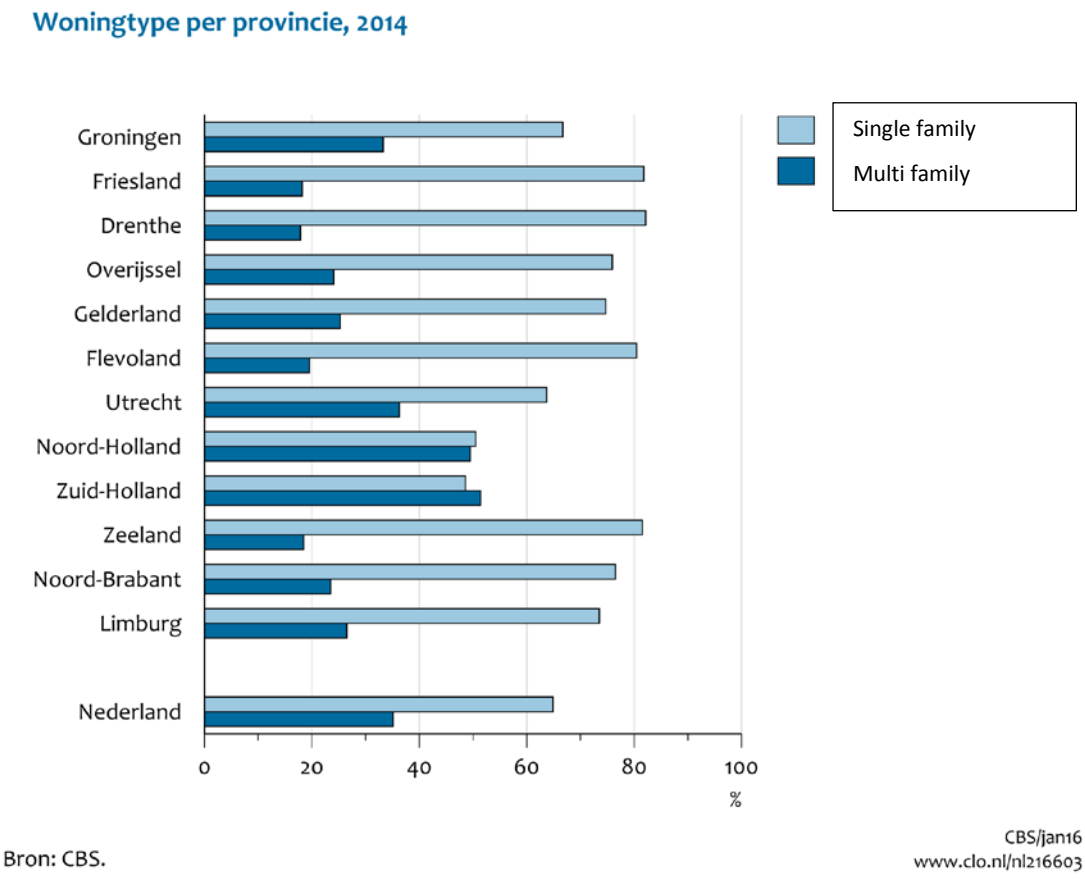
Building stock as function of the period of construction



Relative building stock as function of the building type:
Detached (15%)/semi-detached (12%)/terraced (42%)/multi-family (30%)

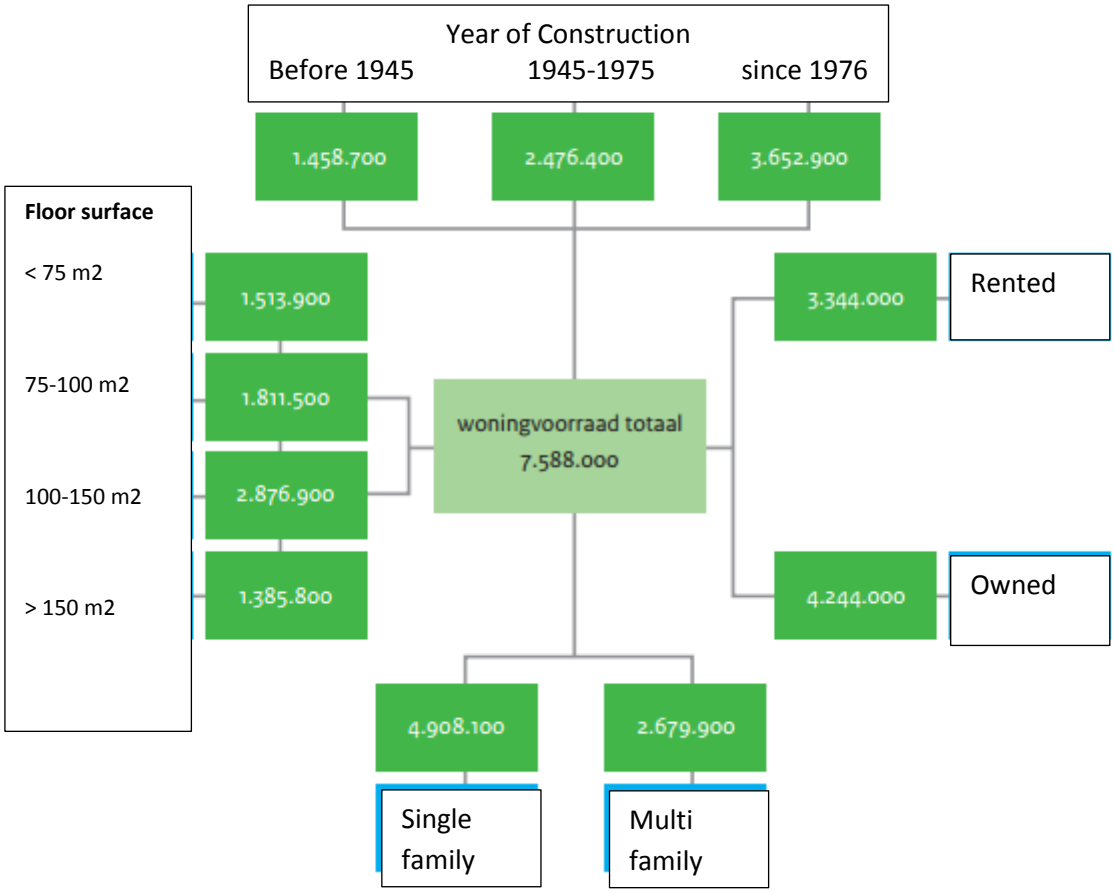
Most common types of heating systems are:

- In single-floor apartments in large buildings:
  - Block heating (central boilers) with central DHW-production/storage;
  - Block heating (central boilers) with individual instant DHW-production (“geiser”);
  - Block heating (central boilers) with individual electrical storage water heaters;
  - Individual Combi boilers (SH and DHW delivered by the same (HE-)boiler).
- In two-floor apartments (“maisonettes”):
  - Individual Combi boilers (SH and DHW delivered by the same (HE-)boiler).



Relative part of houses in MF Buildings per area (Dutch Provinces)

Woningvoorraad naar eigendom, woningtype, bouwjaar en oppervlakte, 2015



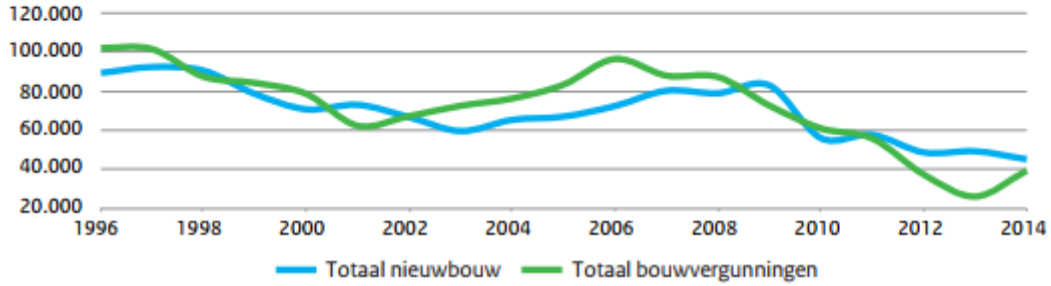
Dutch building stock in 2015, divided in four different ways

Source: brochure-cijfers-bouwen-v10 – Cijfers over wonen en bouwen 2016

Voltooide nieuwbouwwoningen totaal en afgegeven bouwvergunningen naar opdrachtgever, 1996-2015

	Nieuwbouw	Afgifte bouwvergunningen			
	totaal nieuwbouw	overheid en woning corporaties	bouwers voor de markt	overige opdrachtgevers	totaal afgiften
1996	89.100	24.100	62.300	15.700	102.100
1997	92.300	23.000	64.400	14.100	101.500
1998	90.500	19.300	54.100	14.100	87.400
1999	78.600	15.700	54.900	13.600	84.200
2000	70.700	14.700	51.000	12.800	78.600
2001	73.000	11.500	40.800	10.100	62.300
2002	66.700	14.100	44.900	8.200	67.200
2003	59.600	18.200	47.200	7.100	72.500
2004	65.300	20.900	47.300	8.000	76.200
2005	67.000	22.600	52.500	8.200	83.300
2006	72.400	23.000	64.300	9.200	96.400
2007	80.200	25.600	53.300	9.000	87.900
2008	78.900	25.000	53.200	9.000	87.200
2009	82.900	25.000	39.600	8.000	72.600
2010	56.000	17.900	36.100	7.000	61.000
2011	57.700	15.700	33.500	6.600	55.800
2012	48.700	12.100	20.600	4.600	37.400
2013	49.300	6.900	15.400	3.800	26.200
2014	45.200	7.100	27.400	4.900	39.400
2015	47.900				

Totaal nieuwbouw en afgegeven bouwverguningen, 1996-2014

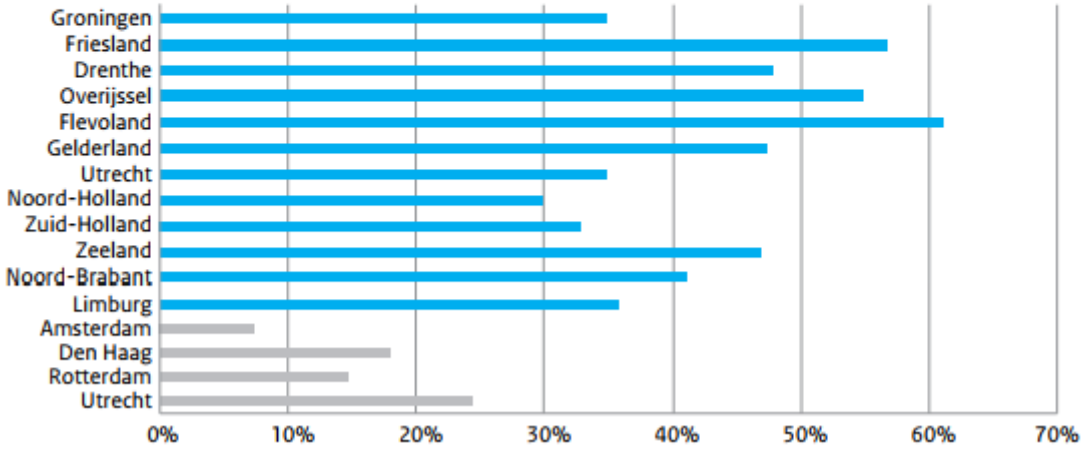


Realized new homes and building permits granted

Voltooide nieuwbouwwoningen naar woningtype en aantal kamers, 2013

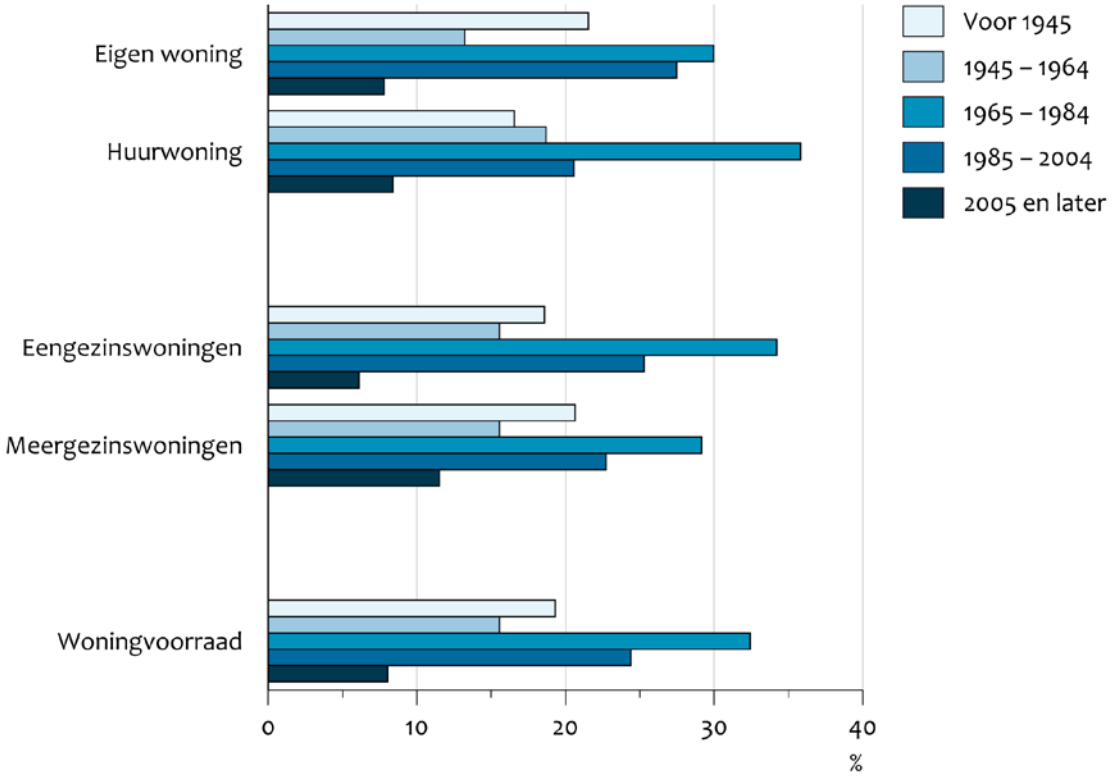
	Nieuwbouw	Woningtype		Gebruiksoppervlakte			
	totaal	eengezins	meergezins	-90 m²	90-119 m²	120-149 m²	150+ m²
Groningen	1.463	507	956	934	232	143	153
Friesland	1.314	746	568	454	403	288	169
Drenthe	1.277	610	667	463	372	242	200
Overijssel	2.752	1.508	1.244	1.046	618	438	647
Flevoland	1.120	683	437	501	218	224	177
Gelderland	6.194	2.924	3.270	2.499	1.643	1.077	975
Utrecht	3.747	1.301	2.446	1.797	992	553	405
Noord-Holland	7.842	2.334	5.508	3.952	2.078	1.020	792
Zuid-Holland	11.011	3.623	7.388	5.086	3.209	1.672	1.044
Zeeland	784	367	417	313	286	94	91
Noord-Brabant	9.748	3.999	5.749	4.519	2.861	1.181	1.187
Limburg	2.001	717	1.284	975	496	244	285
Nederland	**49.311**	**19.347**	**29.964**	**22.562**	**13.414**	**7.187**	**6.137**
Amsterdam	2.501	185	2.316	1.689	609	161	42
Rotterdam	1.629	238	1.391	869	535	123	102
Den Haag	2.013	361	1.652	1.370	368	226	49
Utrecht	960	234	726	516	267	144	33

Percentage eengezinswoningen in de nieuwbouw



Relative number of single family houses by region (Dutch Provinces) – the other part are apartments in MFB

Woningen naar eigendom, woningtype en bouwjaar



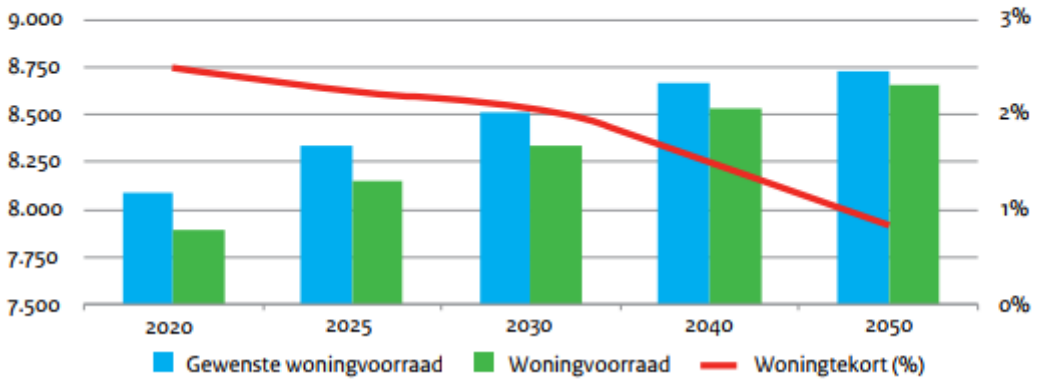
Bron: CBS.

CBS/jan16
www.clo.nl/nl216603

Berekening woningbehoefte (x 1.000), 2015-2050

		2015	2020	2025	2030	2040	2050
Huishoudens totaal		7.665	8.021	8.265	8.435	8.591	8.655
Urgente starters	+	135	146	150	149	145	149
Urgente woningverlaters	-	8	8	8	8	9	9
Huishoudens plus saldo urgenten	=	7.792	8.159	8.407	8.576	8.727	8.795
Huishoudens vrijwillig in niet-woning	-	290	299	304	298	295	307
Woningbehoevende huishoudens	=	**7.502**	**7.861**	**8.102**	**8.277**	**8.432**	**8.489**
Tweede woningen	+	9	9	9	9	9	9
Gewenste leegstand	+	160	171	173	175	175	178
Ongeschikt voor bewoning	+	49	49	49	50	50	50
Gewenste woningvoorraad	=	**7.721**	**8.090**	**8.334**	**8.511**	**8.667**	**8.726**
Woningvoorraad		7.588	7.888	8.148	8.335	8.536	8.657
Woningtekort [-] of -overschot [+]	=	-133	-202	-186	-176	-131	-70
als % van de woningvoorraad		**-1,8%**	**-2,6%**	**-2,3%**	**-2,1%**	**-1,5%**	**-0,8%**

Woningvoorraad en gewenst woningvoorraad (x 1.000), 2015-2050

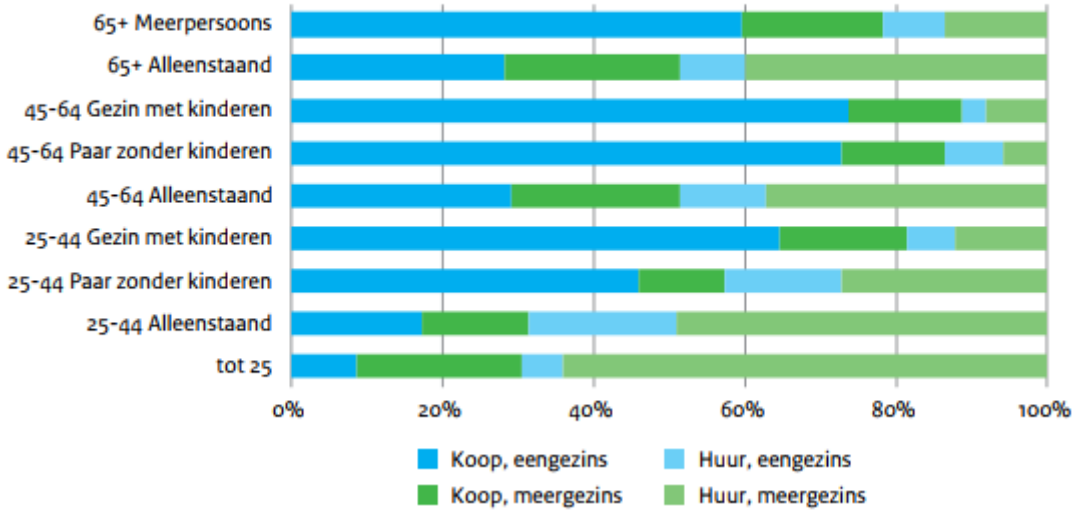


Expected number of homes, needed on the market (blue) and available (green); red line: shortage in %

Huisvesting naar type huishouden en woning (x 1.000), 2015

	Koop, eengezins	Huur, eengezins	Koop, meergezins	Huur, meergezins	Totaal
tot 25	20	48	12	142	221
25-44 Alleenstaand	129	107	147	369	752
25-44 Paar zonder kinderen	184	47	62	109	401
25-44 Gezin met kinderen	716	185	74	133	1.109
45-64 Alleenstaand	227	172	88	287	774
45-64 Paar zonder kinderen	562	108	59	45	774
45-64 Gezin met kinderen	958	194	41	102	1.295
65+ Alleenstaand	252	203	79	355	889
65+ Meerpersoons	631	200	87	144	1.063
Totaal	**3.679**	**1.265**	**648**	**1.685**	**7.278**

Type bewoning (%), 2015

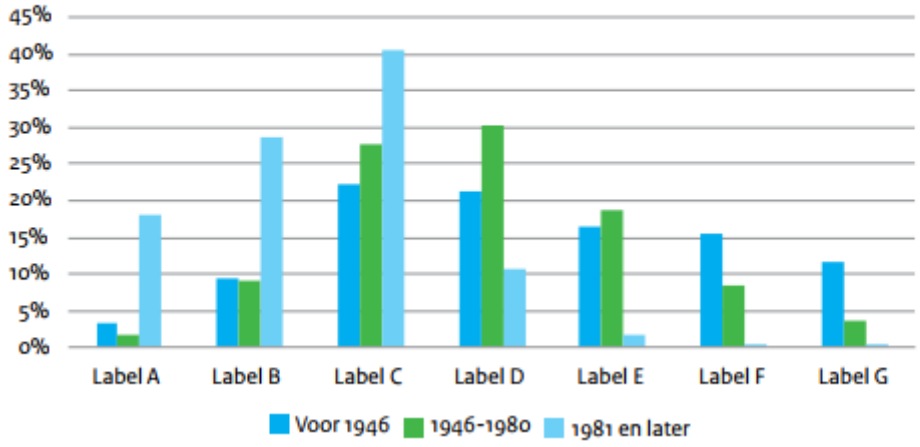


Occupancy by age and composition of households

Energetische kwaliteit woningen naar bouwjaar (x 1.000 woningen), 2015

	Voor 1946	1946-1980	1981 en later	Totaal
Label A	10	21	193	224
Label B	27	127	308	462
Label C	65	383	436	883
Label D	62	419	115	595
Label E	48	260	17	324
Label F	45	118	4	167
Label G	34	50	2	86
Totaal	**291**	**1.377**	**1.074**	**2.742**
Label onbekend	*1.064*	*1.654*	*1.818*	*4.536*

Energetische kwaliteit naar bouwjaar (%), 2015

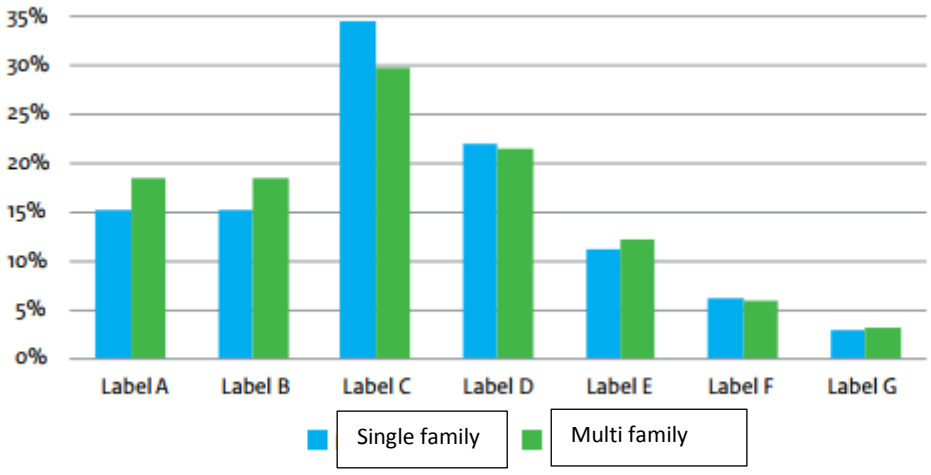


Energy quality by construction period (label A: lowest energy use)

Energetische kwaliteit woningen naar woningtype (x 1.000 woningen), 2015

	Eengezinswoning	Meergezinswoning	Totaal
Label A	106	118	224
Label B	212	251	462
Label C	478	405	883
Label D	305	291	595
Label E	157	167	324
Label F	87	80	167
Label G	42	44	86
Totaal	**1.387**	**1.355**	**2.742**

Energetische kwaliteit naar woningtype (%), 2015

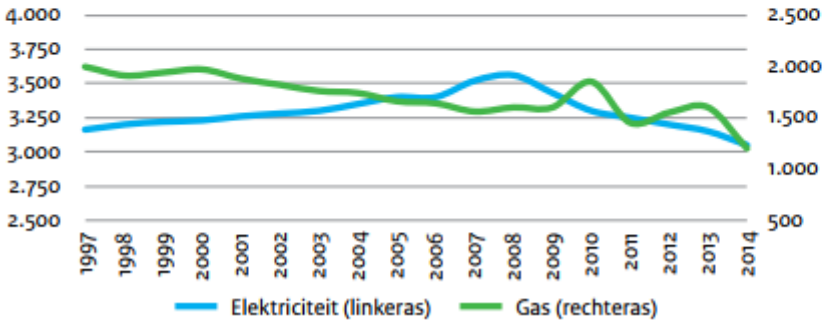


Energy quality by type (label A: lowest energy use)

Gemiddeld energieverbruik van huishoudens per toepassing, 1997-2014

	Gemiddeld gasverbruik per huishouden (m³)	Gemiddeld elektriciteitsverbruik (kWh)
1997	2.000	3.160
1998	1.910	3.200
1999	1.940	3.220
2000	1.970	3.230
2001	1.880	3.260
2002	1.820	3.280
2003	1.760	3.300
2004	1.740	3.350
2005	1.660	3.400
2006	1.640	3.400
2007	1.560	3.520
2008	1.600	3.560
2009	1.600	3.430
2010	1.850	3.300
2011	1.450	3.250
2012	1.550	3.200
2013	1.600	3.150
2014	1.200	3.050

Gemiddeld gas- en elektriciteitsverbruik (m³ en kWh) van huishoudens, 1997-2014



Average use of gas and electricity per household

Bouwperiode		Type woning							
		Single family			Multi family				
		Vrijstaand	2/1-kap- of hoekwoning	Tussenwoning	Maisonnette	Galerij	Portiek	Flat	Totaal
t/m 1964	label	G	F	F/G	G	D	E/F	E	
	aantal woningen	441.000	285.000	1.001.000	226.000	69.000	523.000	99.000	**2.644.000**
	energiegebruik (GJ)	201	148	98-142	114	42	52-69	52	
t/m 1974	label	F	E	E	D	E	D	E	
	aantal woningen	119.000	142.000	606.000	22.000	174.000	112.000	125.000	**1.300.000**
	energiegebruik (GJ)	178	133	91	68	59	46	59	
t/m 1991	label	D	C	D	C	C	C	C	
	aantal woningen	221.000	224.000	879.000	94.000	109.000	142.000	125.000	**1.794.000**
	energiegebruik (GJ)	119	88	71	50	36	40	37	
t/m 2005	label	B	B	C	B	B	B	B	
	aantal woningen	178.000	173.000	335.000	40.000	113.000	70.000	136.000	**1.045.000**
	energiegebruik (GJ)	96	76	59	43	33	40	37	
t/m 2010	label	A	A	A	A	A	A	A	
	aantal woningen	48.000	28.000	165.000	15.000	34.000	37.000	32.000	**359.000**
	energiegebruik (GJ)								
	Totaal	**1.007.000**	**852.000**	**2.986.000**	**397.000**	**499.000**	**884.000**	**517.000**	**7.142.000**

Tabel 1 Energielabels per woningtype en bouwperiode. *Bron: Agentschap NL*

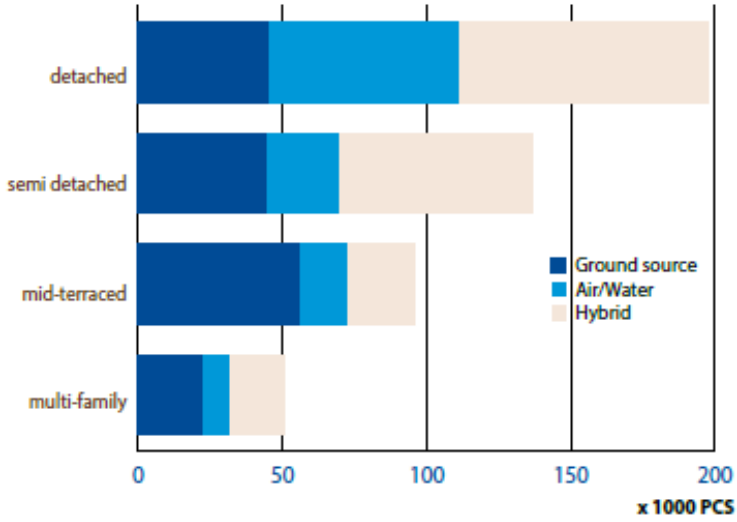
Energy label (A-G), number of houses and energy use (GJ/year) as function of the year of construction

4 Market of heating systems in multifamily buildings

The basic assumptions used for the penetration of heat pumps are as follows:

- The number of individual households will rise from 7.27 million in 2013, to 8.0 in 2020 and 8.4 in 2030, whereby it is assumed that almost every household will have its own individual heating and hot water supply.
- The energy demand in new housing will drop even further until 2020, after which there will be energy neutral or passive housing.
- New housing in the period up until 2020, expected to be 40,000-45,000/year, will on average be divided 30:70 among the rental sector/private sector. In the period of 2020-2030, there will likely be a stronger growth in new residences for the rental sector, partially due to the aging of the population.
- The heat pump market is developing according to the scenario of a maximum of 500,000 heat pumps in 2020 and a maximum of 1.8 million installed in 2030.

Housing supply:



Number of heat pumps in housing in 2020, divided according to segments in construction and type of heat pump (Source: DHPA, BDH)

Most corner houses are comparable energy-wise to half of a semi-detached building; they are treated as such in all figures and tables in this publication.
The flats consist of four subcategories: maisonettes, gallery flats, flats with an entrance hall and flats. These subcategories have various architectural, energy and user characteristics.

For this document we assume an average profile of all flats.
The categories of detached housing and semi-detached housing (and corner residences) show the most growth relatively between 1964 and 2010, with a factor of four and seven, respectively. The increase in prosperity of the last fifty years has translated clearly in the say people live in the Netherlands and in which kind of housing.
The table below shows an overview of the most relevant characteristics of the housing supply in the Netherlands, based on a total supply of 7.27 million buildings in 2013.

Housing type	Qty of houses	Power consump-tion kWh/ annually	Natural gas consump-tion m³ annually	Heating demand for space heating in GJ
detached	1.018.251	4.357	2.820	61
semi-detached	861.520	3.736	1.942	39
mid-terraced	3.037.564	3.432	1.625	31
multi-family	2.322.665	2.372	991	16

	Detached	Semi-detached	Mid-terrace	Multi-family
% of the building stock	15	23	30	32
Ownership/rented in %	100	88/12	66/33	40/60
Power consumption in kWh:				
Housing before 1946 average up to	4.130	3.670	3.240	2.500
Housing after 2010 average	4.840	3.950	3.520	2.890
Natural gas consumption in m3:				
Housing before 1946 average in GJ/year up to	1.850	1.380	1.050	600
Housing after 2010 average in GJ/year	65	49	37	21
Energy consumption for:				
Domestic hot water	Varying from 430 m³/year for detached house up to 371 m³ for multi-family			
Cooking	35 m³/year			
Energy label indication:				
Housing before 1964	F&G label	Mostly F label	F&G label	E& F label

Overview of indicators of housing supply (AgNL, BDH)

Development of the housing supply up to and including 2030

Because of the economic developments between 2009 and 2013, the volume of new housing has been reduced drastically. Whereas the number of new housing in 2009 was about 80,000, from 2009 to 2013, this number dropped drastically. The expectation was that, in the period between 2013 and 2020, a maximum of an average of 40,000 to 50,000 housing will be produced per year. Recent developments show a slightly better perspective.

After deducting the average demolition of 8,000 to 12,000 housing per year, a net increase of about 28,000 to 42,000 housing annually remains. Assuming an average of a 35,000 net increase in the number of buildings, this comes out to an increase of 245,000 buildings between 2013 and 2020.

From 2020 to 2030, it is expected that at least 420,000 buildings (after deduction of demolition) will be added to the supply.

Given the energy requirements for new housing (EPC 0.6 since 2011 and an expected 0.4 in 2015), it is expected that 65-75% of the new housing after 2020 will be provided with a heat pump for space heating and hot water, whether or not in a hybrid form. In addition, the space heating demand will be reduced strongly by an increasingly better insulated building shell.

5 Heat pumping products in MFB

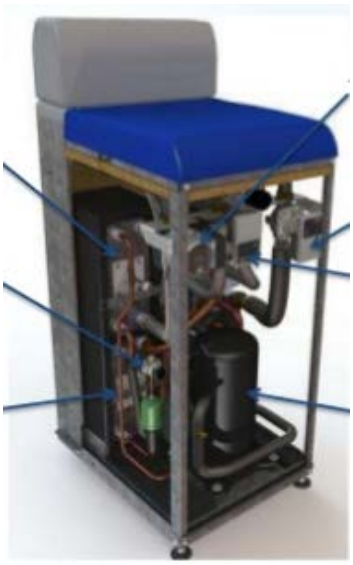
5.1 Products for heating

5.1.1 Ground source heat pumps (collective systems):

Techneco:

Techneco Toros heat pump (available with or without storage vessel for DHW-function) – 2 kW to 18 kW - to be installed in cascade connection

IthoDaalderop:



IthoDaalderop WPU 4th generation heat pump – 4 kW to 7,5 kW - to be installed in cascade connection

Both heat pump types are also applicable as water heater

Techneco (Robur):

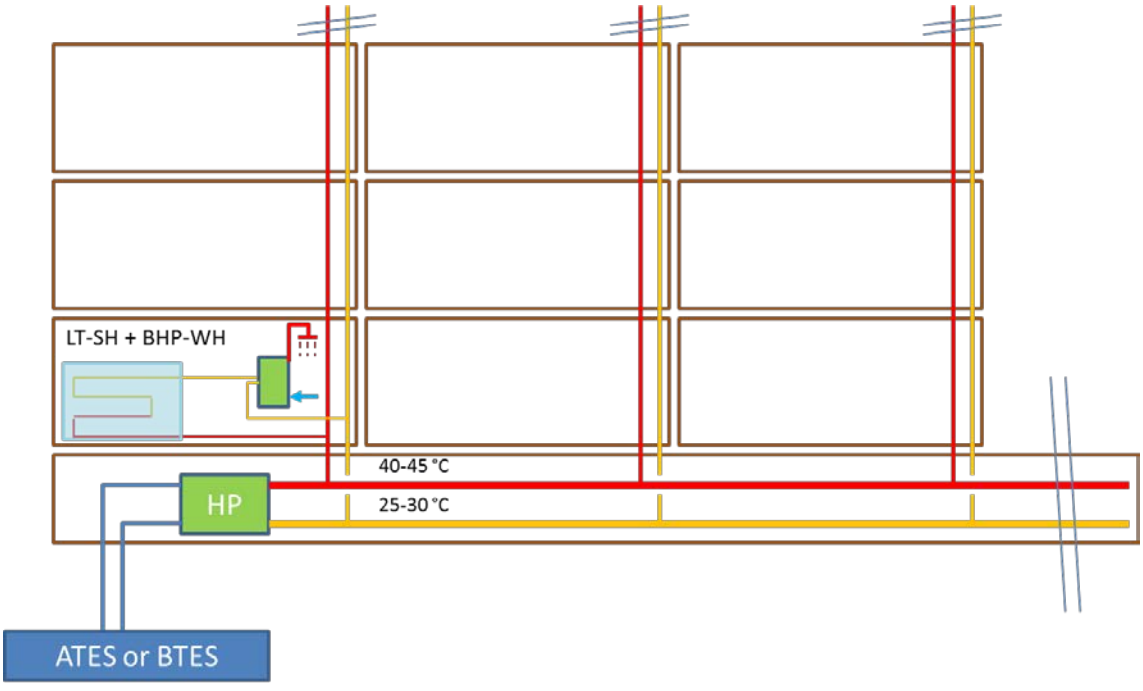
Gasabsorption heat pump (35-40 kW); to be used as add-on heating in collective systems for the base load of space heating

5.2 Products for DHW

5.2.1 Booster heat pump

IthoDaalderop

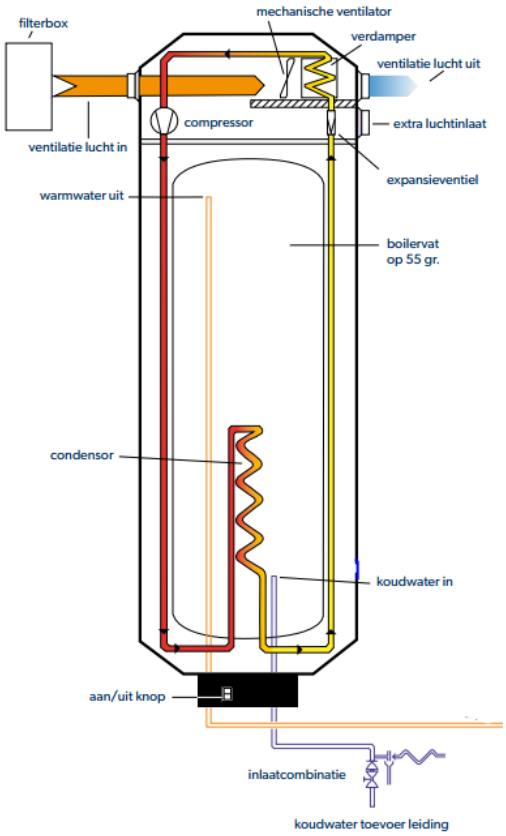
Booster heat pump; right side: with DHW-storage tank



Typical application of a Booster Heat Pump (BHP) in a multi-family building (return of the floor heating system is the source for the BHP).

5.2.2 Exhaust air heat pumps (individual systems):

Inventum



Inventum Optima heat pump (with integrated storage vessel) – approx.. 1,5 kW - to be installed in individual apartments