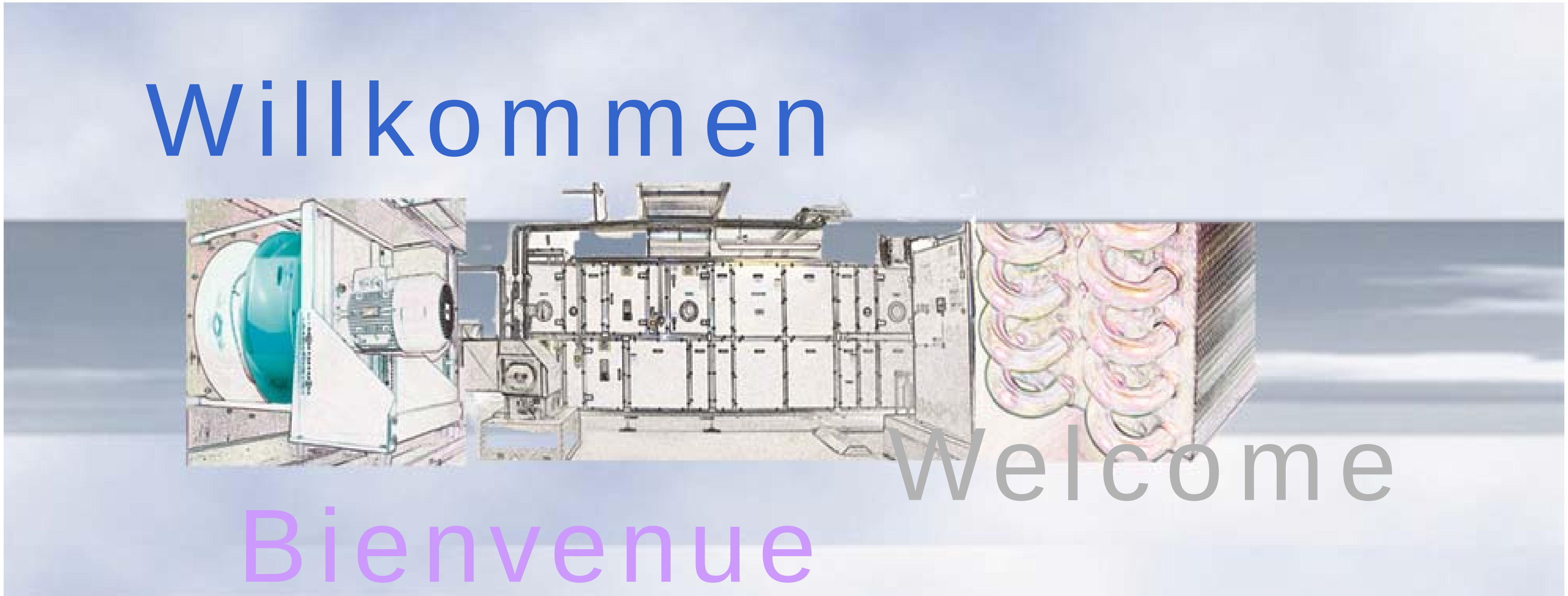

The role of ventilation in the energy turnaround

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Energy in germany

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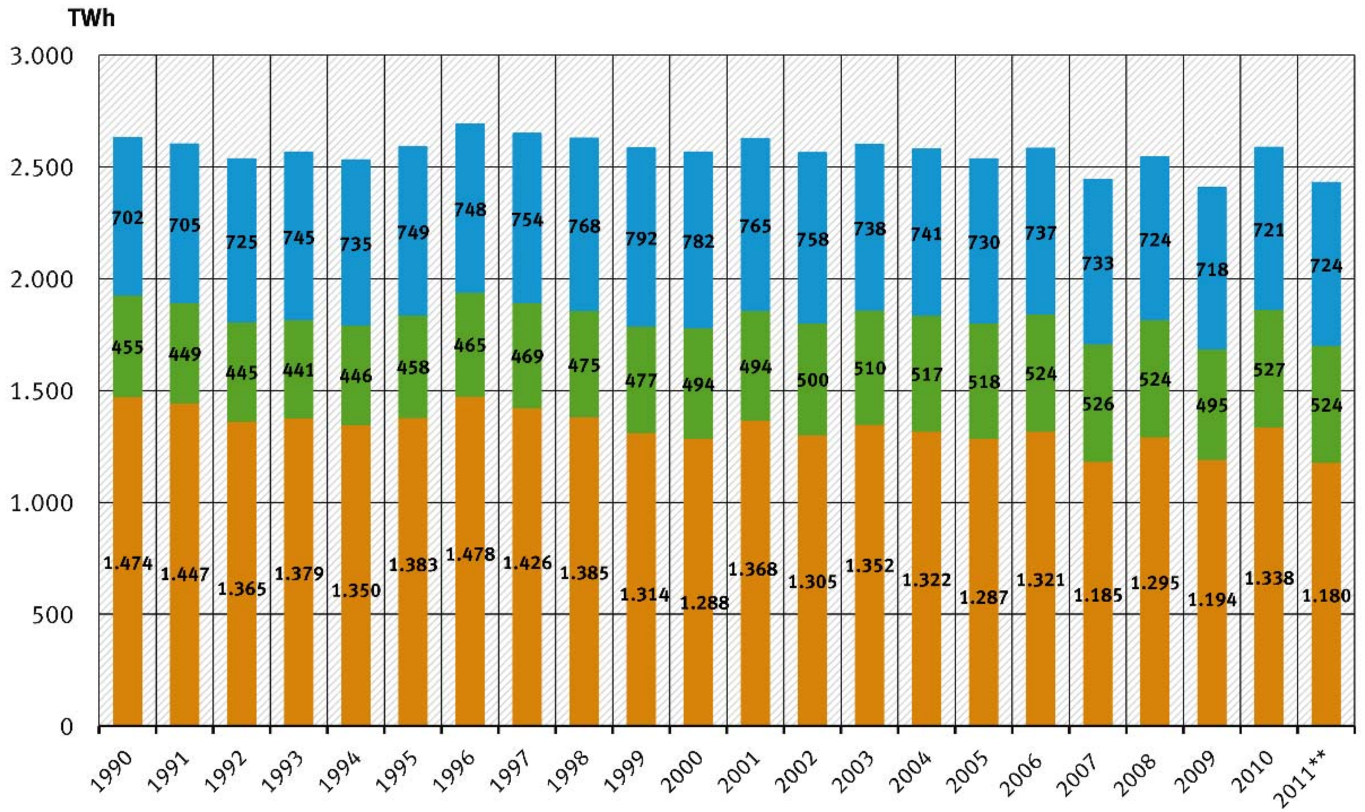
Energyconsumption in germany



fuel

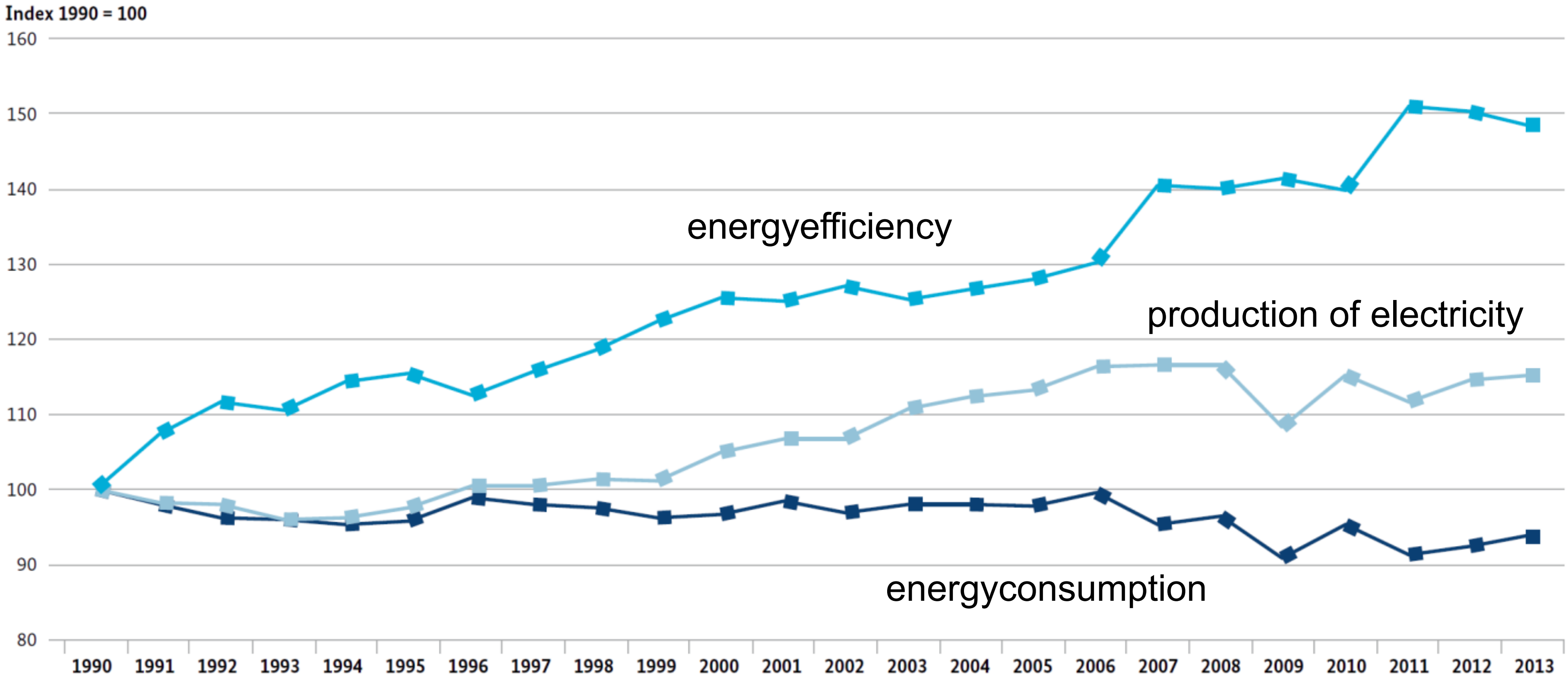
electricity

heat

Quelle: Arbeitsgemeinschaft Energiebilanzen: Auswertungstabellen zur Energiebilanz der Bundesrepublik Deutschland 1990 bis 2011, Stand 09/2012

Energy in germany

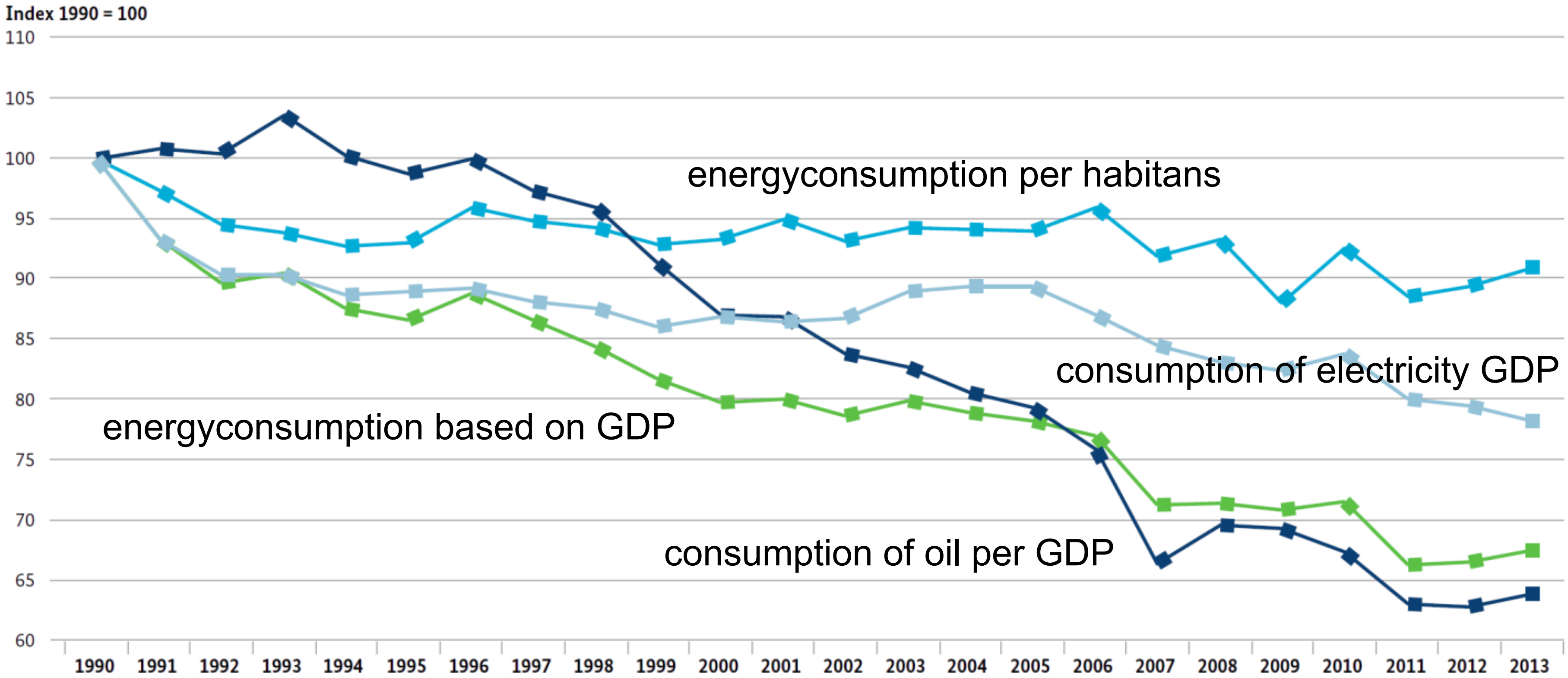
Energyconsumption in germany



Quelle: Arbeitsgemeinschaft Energiebilanzen (AGEB), Statistisches Bundesamt (StBa)

Energy in germany

Energyintension in germany



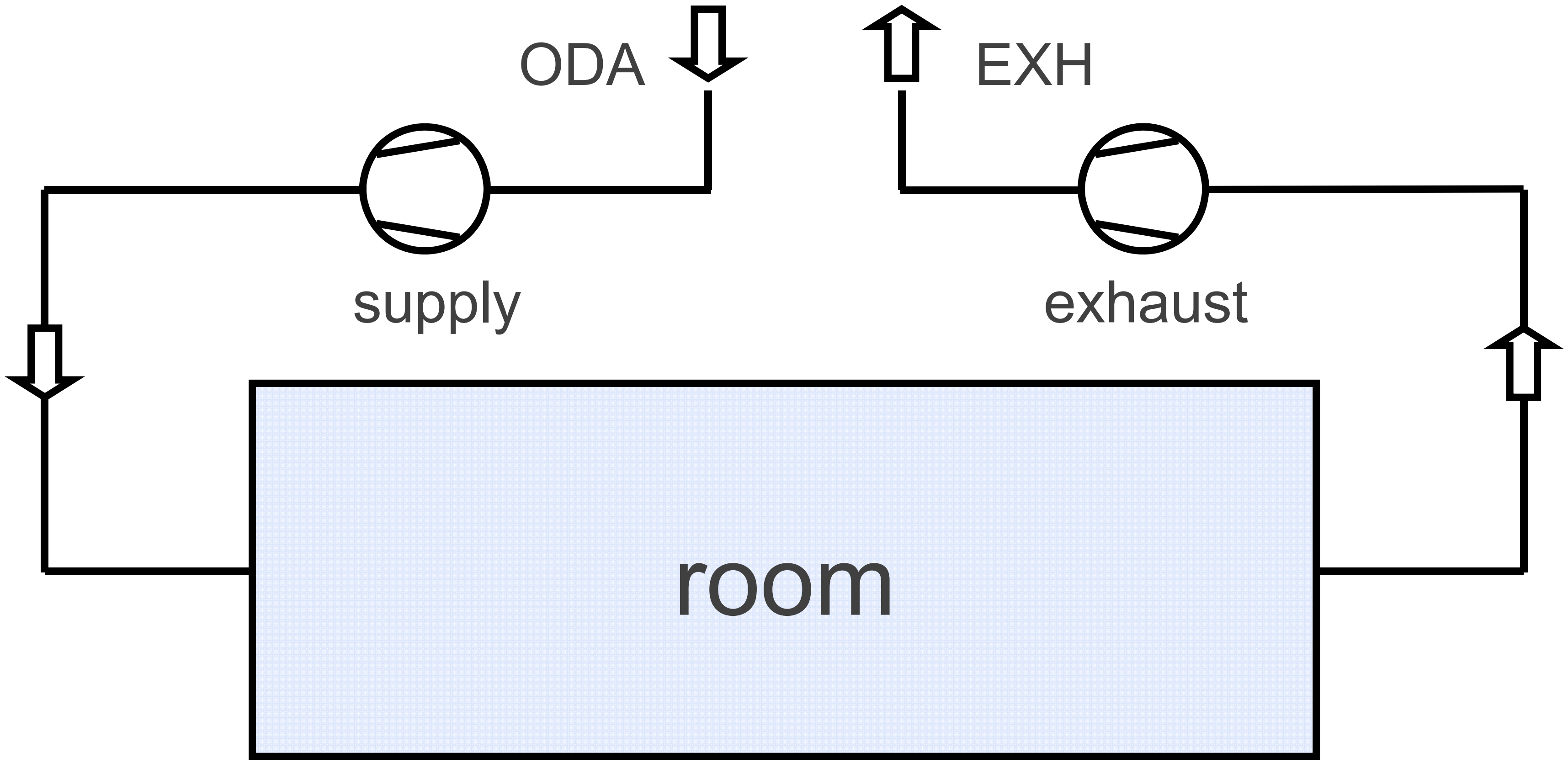
Quelle: Arbeitsgemeinschaft Energiebilanzen (AGEB), Statistisches Bundesamt (StBa)

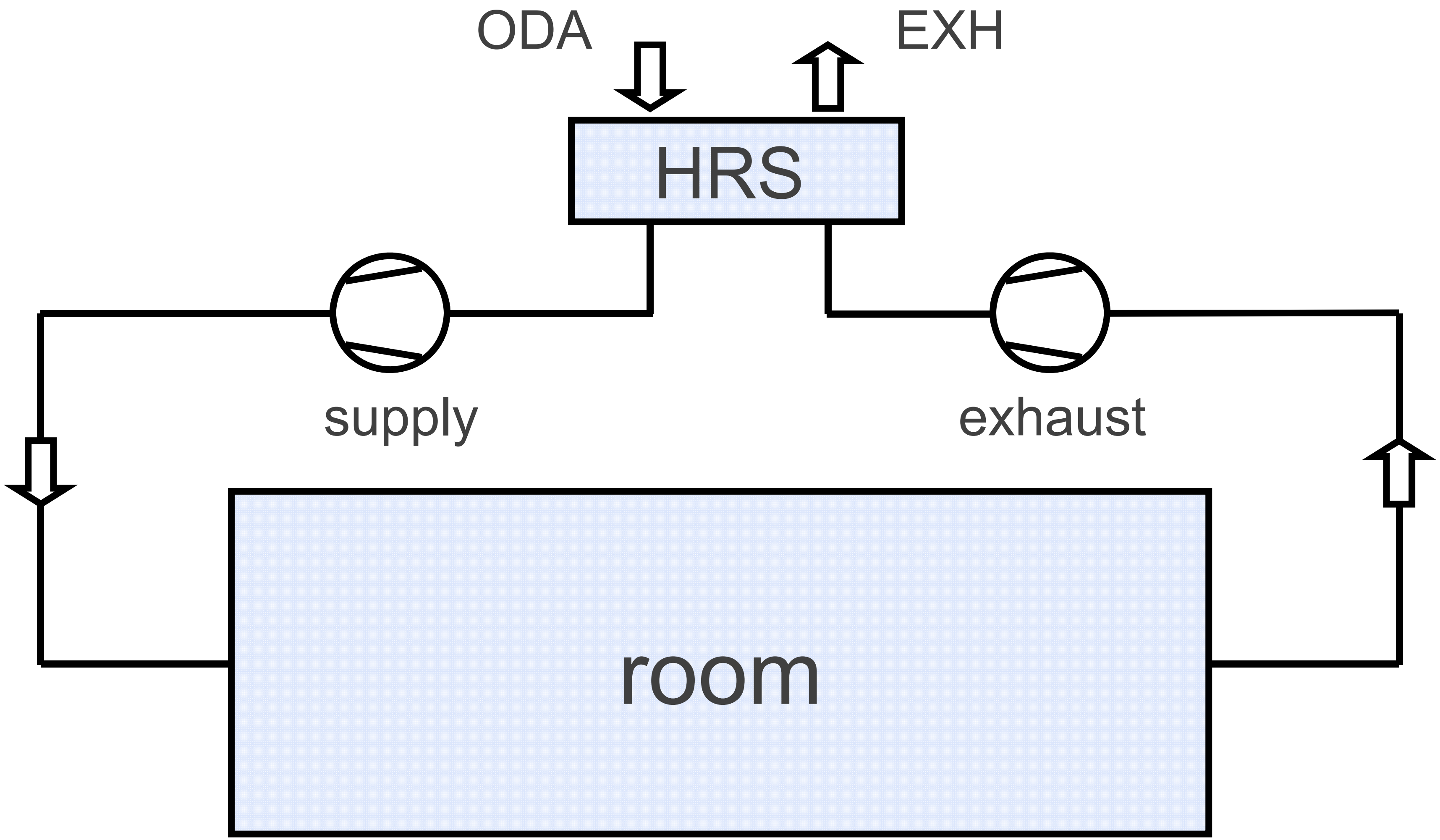
Heating of buildings

Transmission losses
(isulation of the **envelope**)

ventilation losses (35 to 38 %)
(sealing of the **envelope**)

Ventilation




ODA
EXH
HRS
supply
exhaust
room

Heat recovery

Heat recovery is the reusage of **thermal energy** by using the procedures of **heat transfer** in a process of minimum two mass flows with different temperatures.

Goal of heat recovery is to minimize the **demand of primary energy** to heat up or to cool down the outside air to the target value of the required supply temperature.

Heat recovery is using the **enthalpie of the exhaust** or **outside air flow** (heating or cooling), by using the recovered energy in the **original process** (temperating the air) or in another process (**multifunctional use**).

Heat recovery

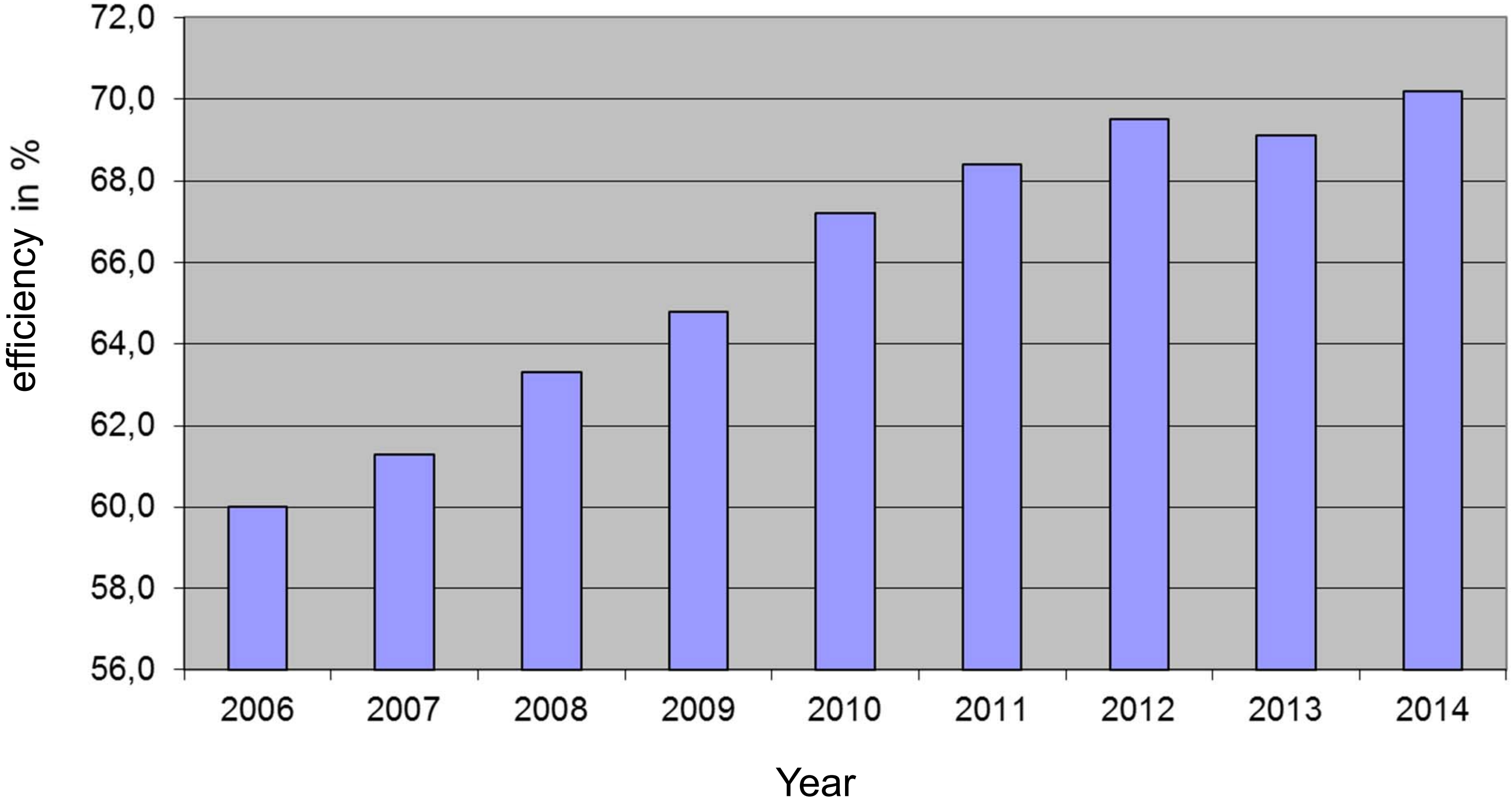
Therefore heat recovery is a **energy efficiency measure**. And heat recovery is a **renewable energy source**. The use of waste heat is „renewed“ to a useable energy by using of heat transfer procedures. HRS is a **renewable process**.

The waste of heat exists parallel to the demand of heat. Therefore the use of waste heat is a **sustainable soure of thermal energy**.

There is **no lag of time** between the **demand of thermal energy** and the **offer of waste heat**.

HRS in NRB in germany

UCB-Study 2014 for



Development of the efficiency of HRS

HRS in NRB in germany

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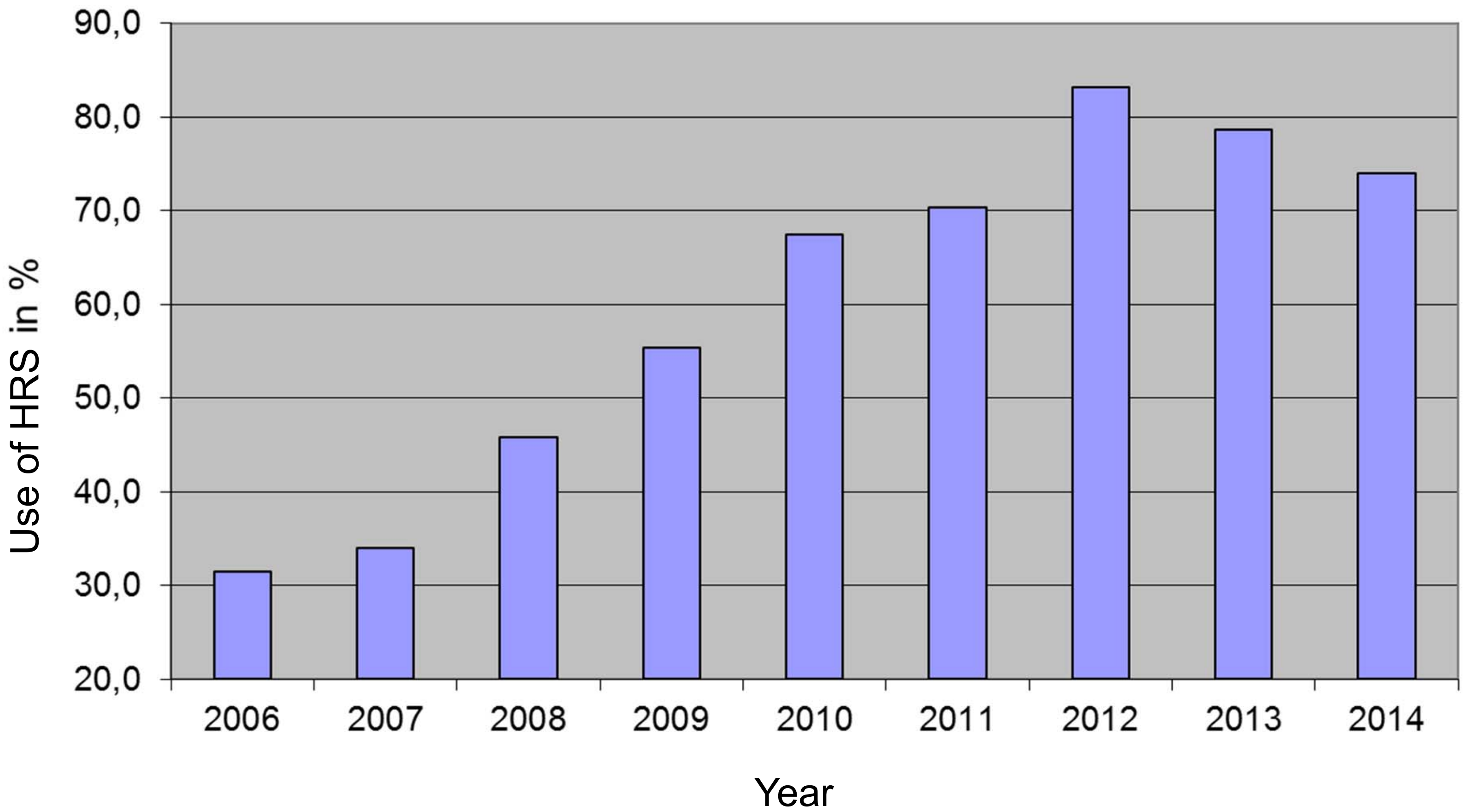

Development of the usage of HRS (possible units)

HRS in NRB in germany

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year	AHU´s	HRS-usage	Φ HRS	ΔP HRS	V SUP	rate RLT	V_D SUP
	units	%	%	Pa	m³/h	% Markt	Mio. m³/h/a
base 13,4 years	25.000	27,5	57,0	165	14.000	70,5	467,7
1993 bis 2005	(estimated average)						
2006	31.857	31,5	60,0	161	13.426	70,5	571,5
2007	30.952	34,0	61,3	160	14.834	70,5	613,5
2008	31.424	45,8	63,3	176	15.667	70,5	657,8
2009	25.295	55,4	64,8	175	15.127	70,5	511,3
2010	26.846	67,4	67,2	182	13.332	70,5	478,2
2011	29.567	70,4	68,4	197	14.028	75,0	520,9
2012	27.885	83,2	69,5	191	13.073	70,0	490,6
2013	22.793	78,6	69,1	181	14.422	75,0	412,9
2014	22.686	73.9	70.2	176	14.796	70.0	448,5

Marked values for germany (D) AHU´s

HRS in NRB in germany

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- under consideration of **80,8 % combined supply and exhaust units** and **13,3, % pure supply units**
- the heat demand during 24-h-operation (8.760 h/a) of average unit lay´s at 31,33 kWh/(m³/h)/a. With a average **operation time** of **2.350 h/a** exists a **demand of heat energy of 8,4 kWh/(m³/h)/a**
- **Multiplication factor** of **13,4** (**20 years live time** with 2 % interest rate und 2 % change rate)
- **renovation rate of 6,4 %** (standard deviation 2,5 %) by survey of experts (n = 10) in 2014 (answers between 3 bis 10 %)
- **primary energy factoren 2,6 for electricity** and **1,1 for oil or gas**

HRS in NRB in germany

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year	demand heating GWh/a	benefit HRS GWh/a	effort HRS $_{el}$ GWh/a	benefit HRS $_{sum.}$ GWh/a	effort HRS$_{el\ sum.}$ GWh/a	Net HRS GWh/a
1993 bis 2005	3.653	573	34,6	**7.674**	**463**	7.237
2006	4.801	907	48,4	**8.523**	**508**	8.053
2007	5.153	1.074	51,4	**9.528**	**556**	9.034
2008	5.526	1.602	79,5	**11.028**	**631**	10.490
2009	4.295	1.542	69,3	**12.471**	**696**	11.909
2010	4.017	1.820	93,3	**14.174**	**783**	13.555
2011	4.376	2.107	124,2	**16.146**	**899**	15.422
2012	4.121	2.383	130,7	**18.376**	**1.022**	17.558
2013	3.468	1.884	102,9	**20.140**	**1.118**	19.247
2014	3.767	1.956	94,4	**21.970**	**1.206**	21.030

Demand of heat energy and HRS (NRB) in germany

HRS in NRB in germany

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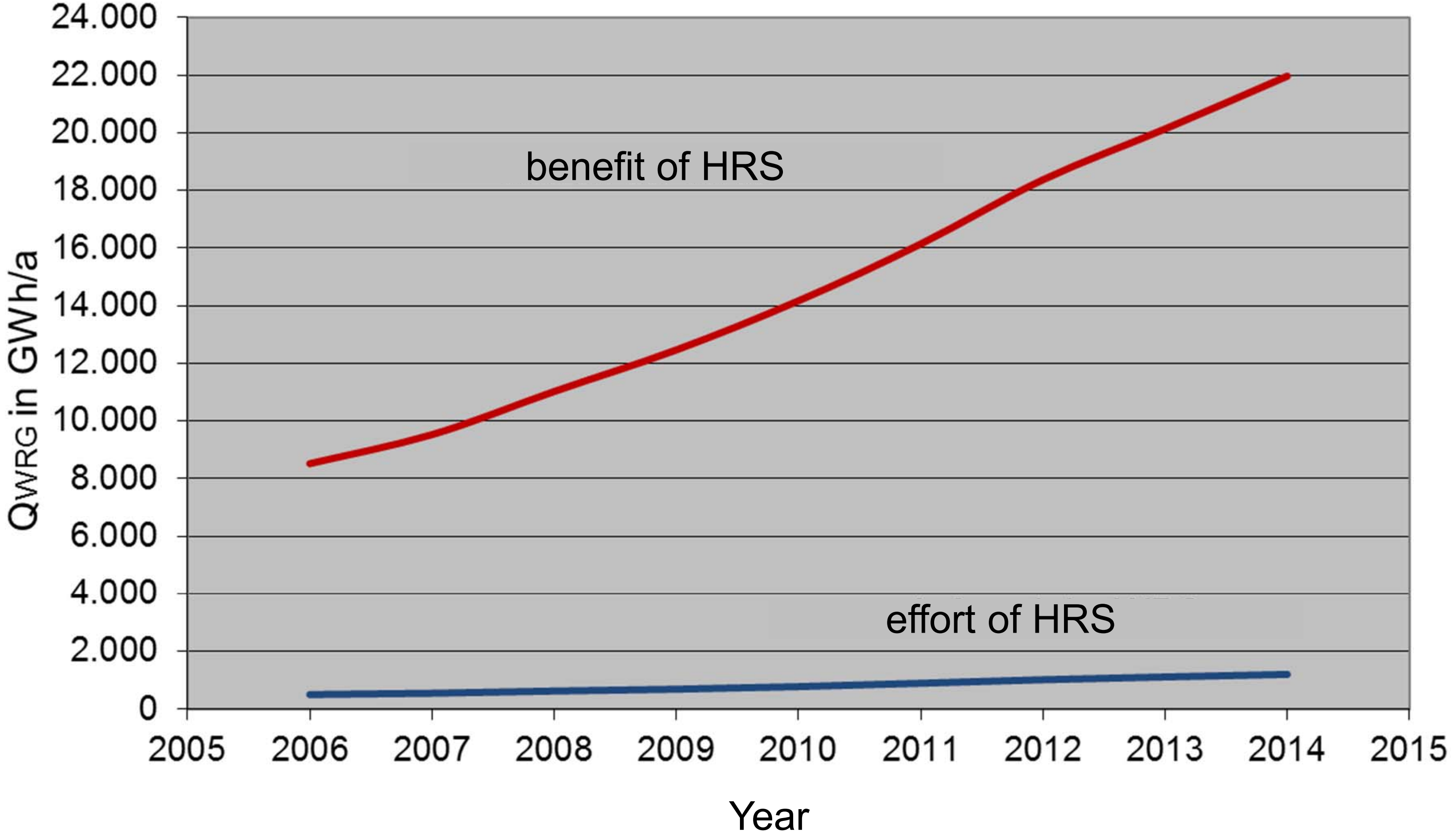


Benefit and effort of heat recovery (energies)

Renewable heat energy provision 2013

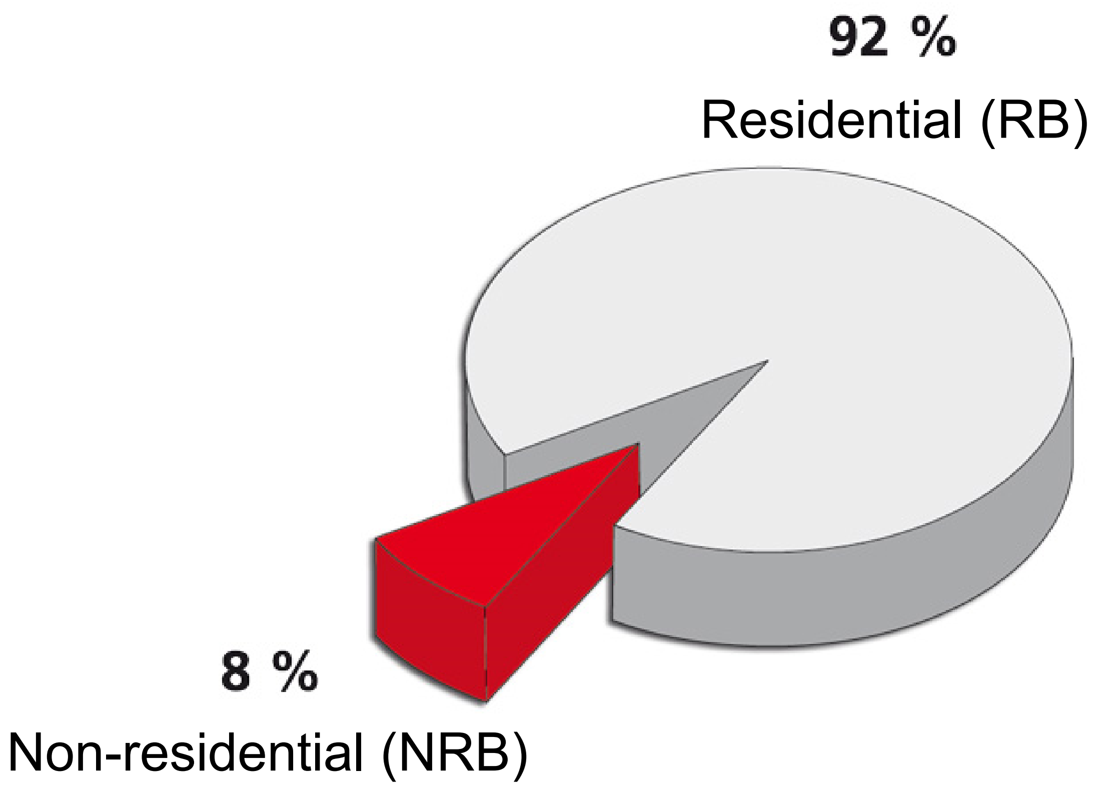
heat pumps	8,5 TWh/a	source 2013
solarthermic	6,8 TWh/a	source ZSW AGEE-Stat. 2014
geothermic	9,5 TWh/a	source ZSW AGEE-Stat. 2014
sum	**24,8 TWh/a**	
heat recovery NRB	**20,1 TWh/a**	
projection 2020	**33,2 TWh/a**	

Buildings in germany

Residential 17,3 Mio units

Non-residential 1,5 Mio units

2007 (D)



75 % built before 1975

Buildings in germany

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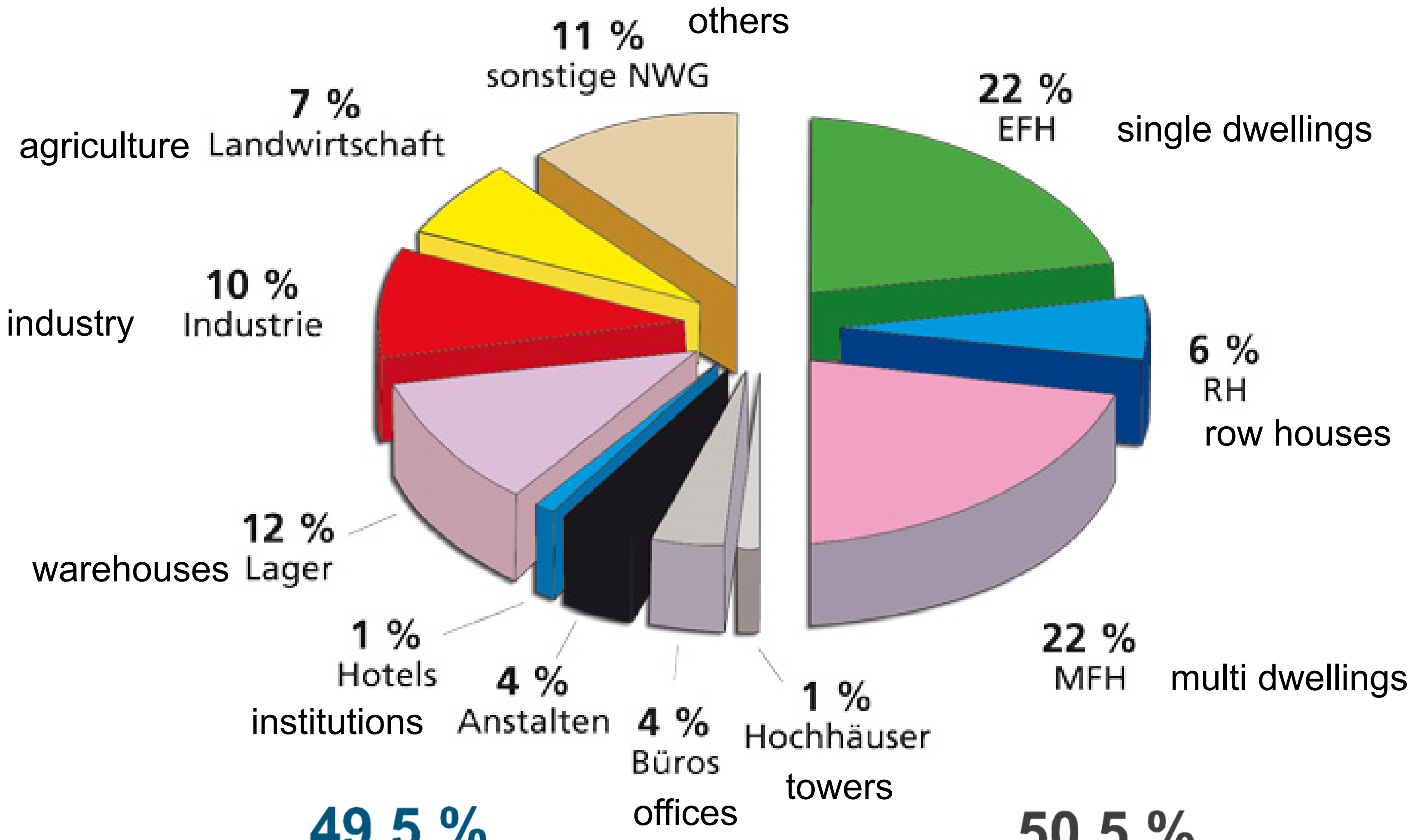

49,5 %

Non-residential (NRB)

1992 (D)

50,5 %

Residential (RB)

Buildings in germay

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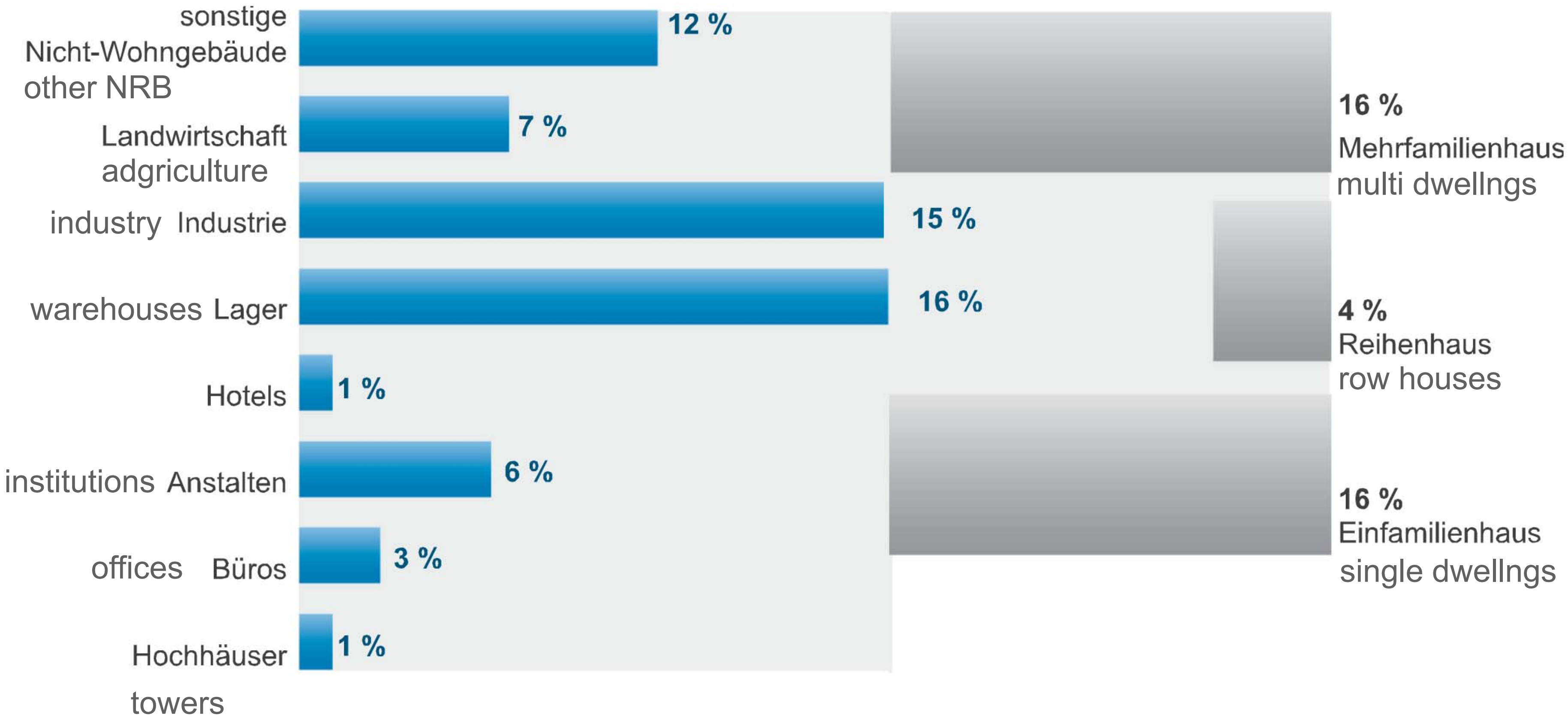

estimation UCB-Study 2010

63,5 %

Non-residential (NRB)

36,5 %

Residential (RB)

UCB-Study 2013 for

Potential in AHU´s

Saving in **residential buildings** (2012) in D	**165 GWh/a (7 %)**
Saving in **non-residential buildings** (2012) in D	**2.302 GWh/a (93 %)**
Saving **residential buildings** (2025) EU	**448 PJ (15 %)**
Einsparung **non-residential buildings** (2025) EU	**2.630 PJ (85 %)**

AHU airflows in NRB

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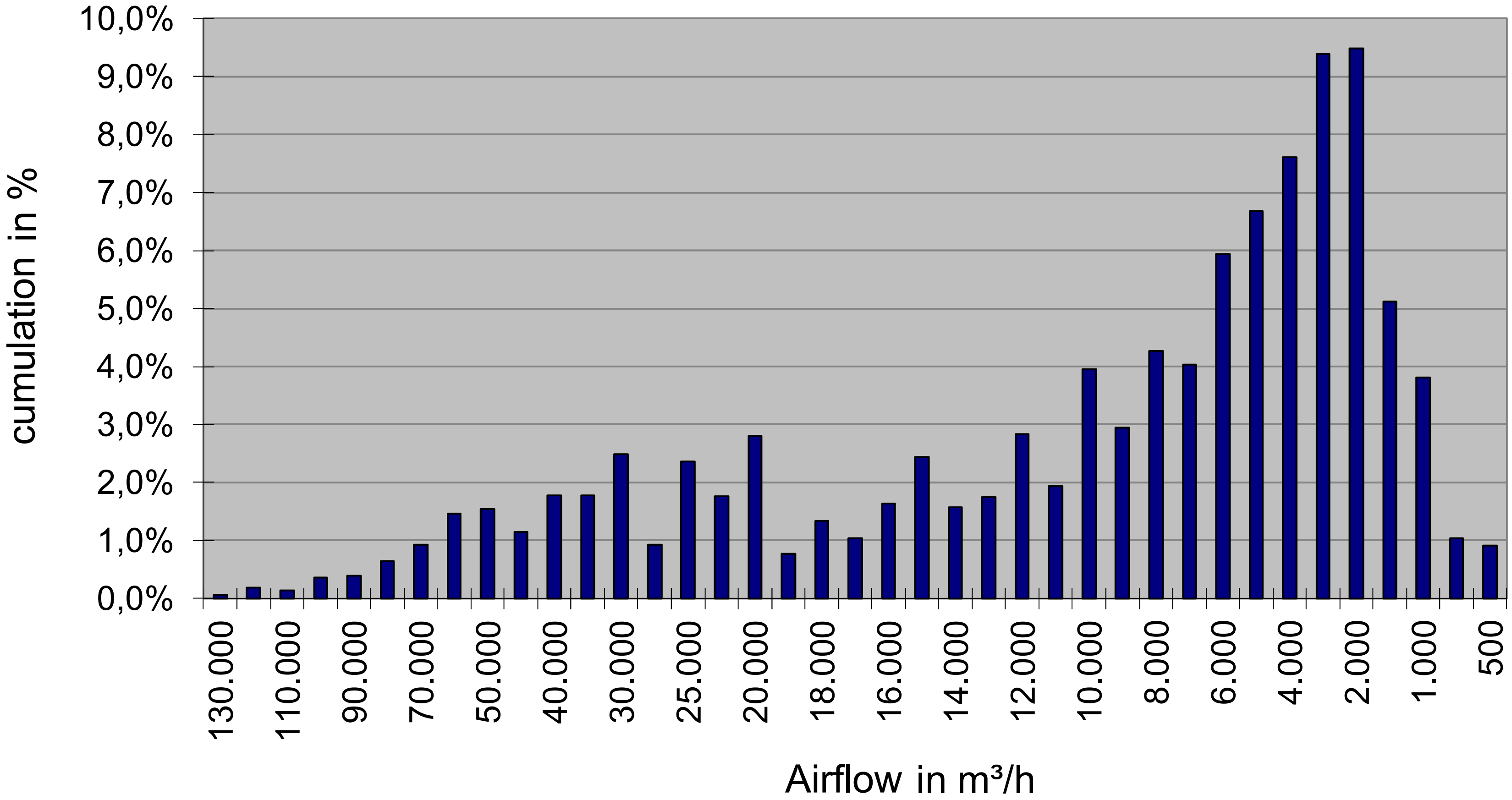
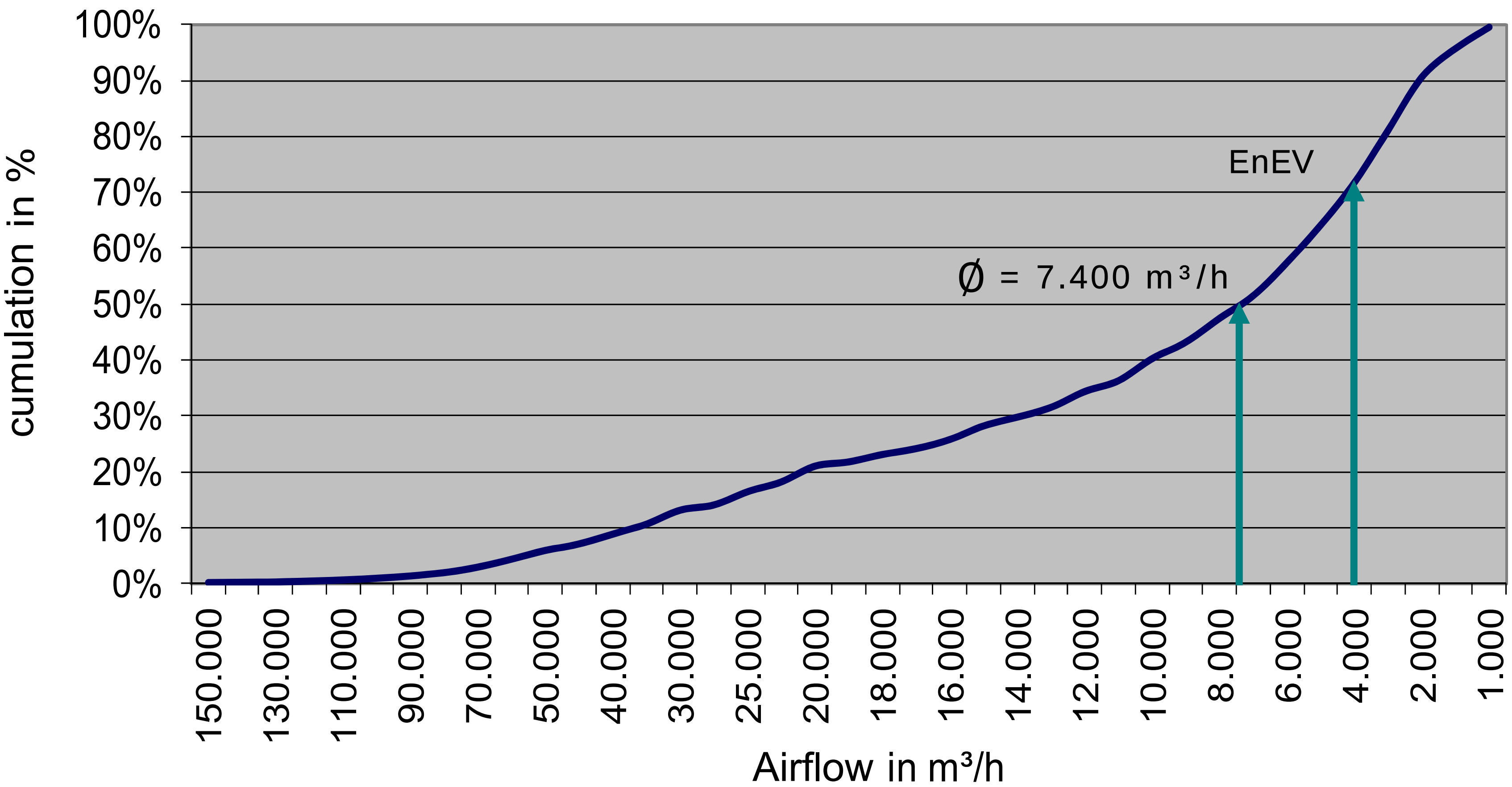
UCB-Study 2010 for EVIA



Air flow rates in NRB

AHU airflows in NRB

UCB-Study 2010 for EVIA



Cumulative frequency of air flow rates in NRB

AHU airflows in NRB

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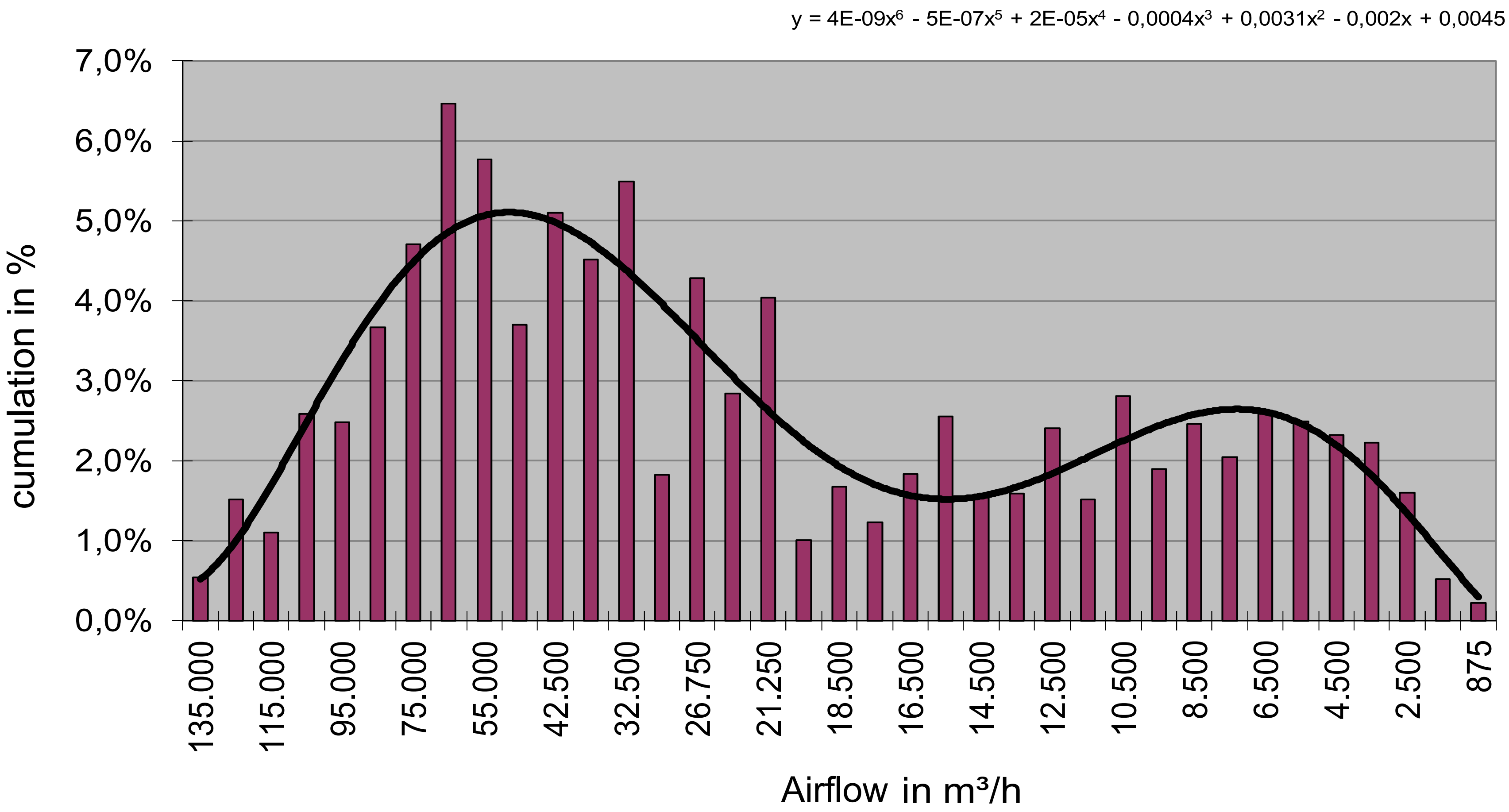
UCB-Study 2010 for EVIA



Heat energy in NRB

AHU airflows in NRB

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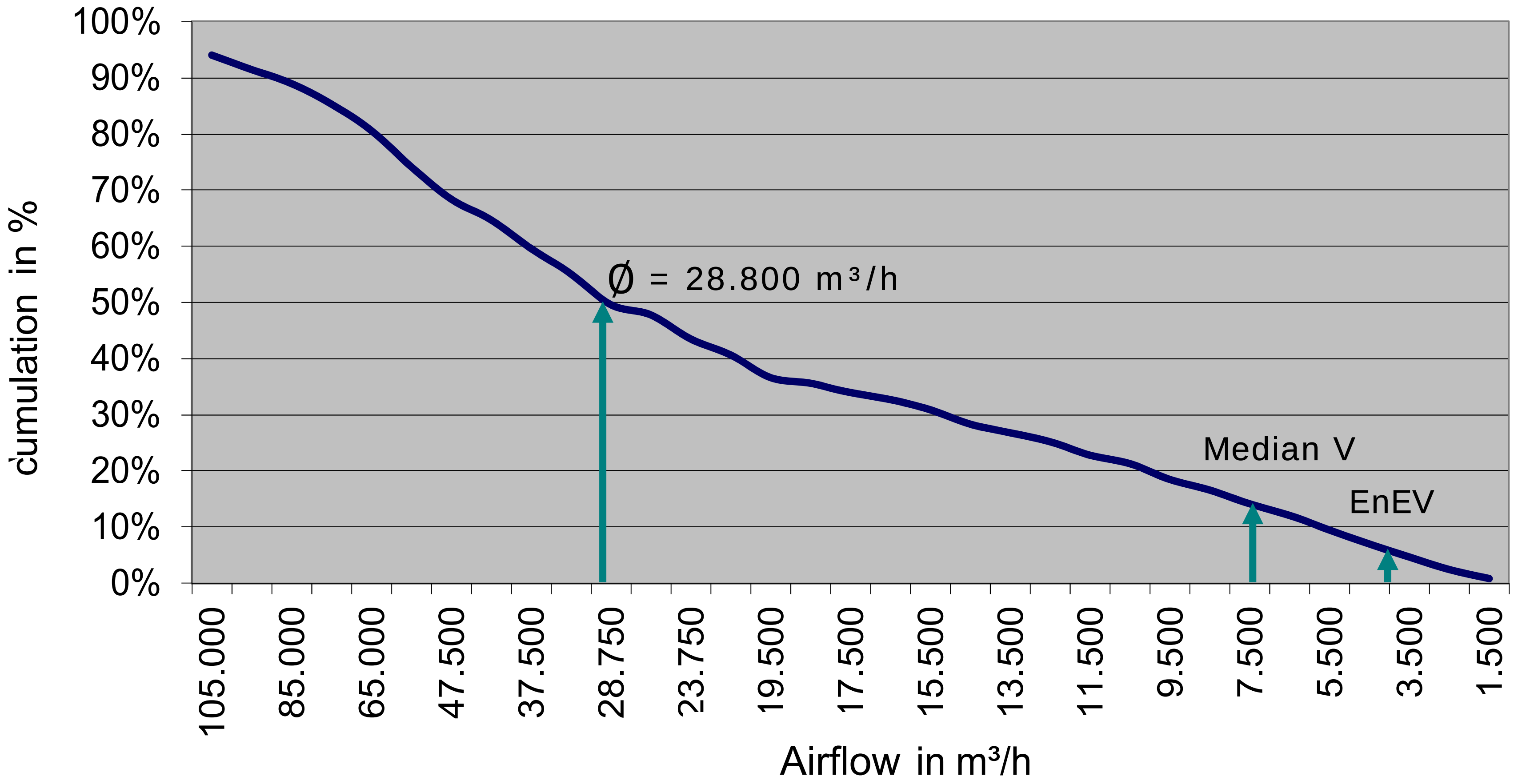
UCB-Study 2010 for EVIA



Cumulative frequency of heat energy in NRB

AHU airflows in NRB

Airflows and energy potential in AHU´s in NRB

Median of **airflows**	ca. **7.400 m³/h**
average airflow of a AHU	ca. **14.400 m³/h**
Median based on **energies**	ca. **28.800 m³/h**

The „factor two x two“ to the relevance of energy

P_{el} in NRB in germany

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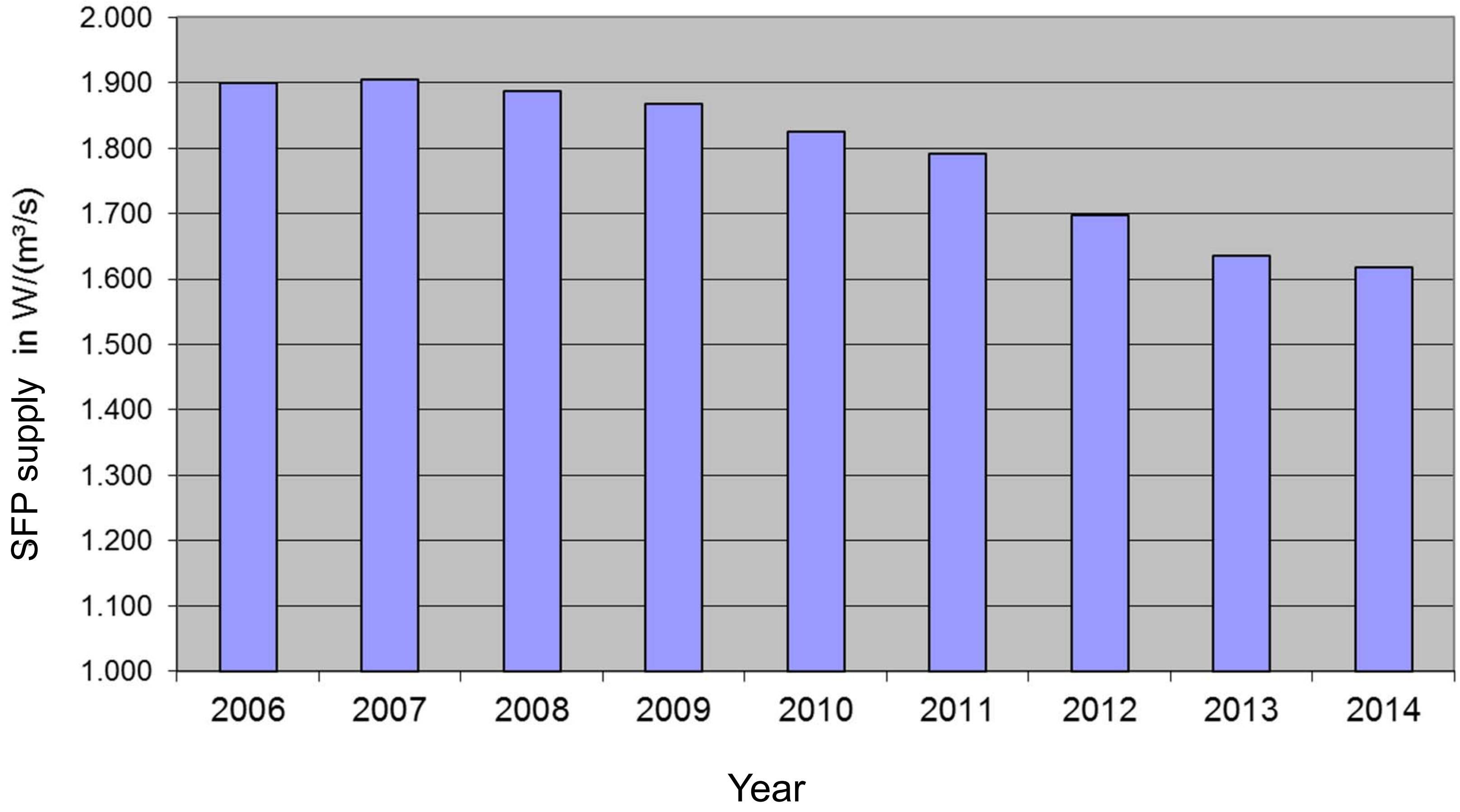
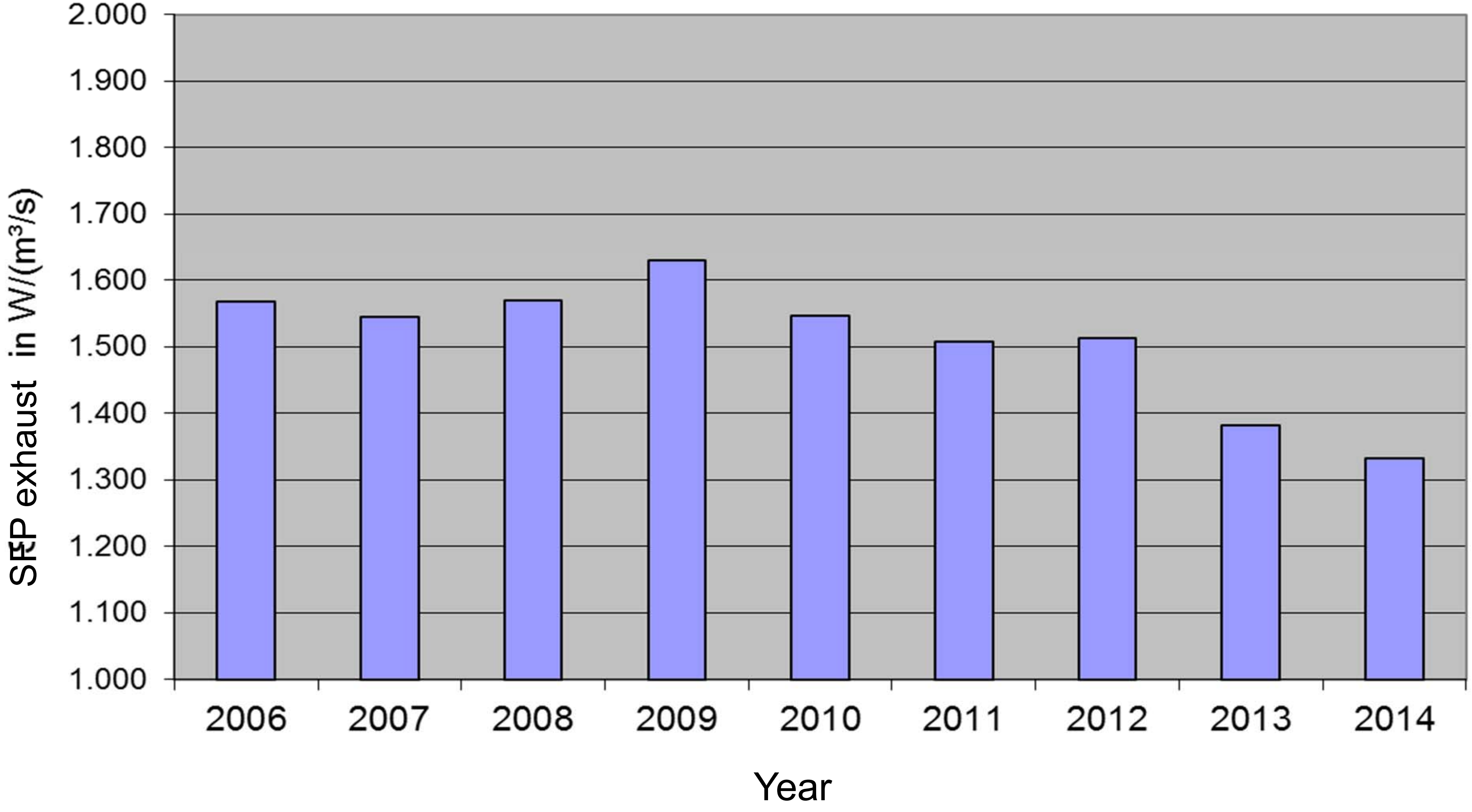
UCB-Study 2014 for



Development of the specific supply-fan power SFP

P_{el} in NRB in germany

UCB-Study 2014 for



Development of the specific exhaust-fan power SFP

P_{el} in NRB in germany

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UCB-Study 2014 for

	SFP SUP	SFP EXH	V EXH	V SUP	AHU´s	Vent	V_D EXH	P_{el} EXH	V_D SUP	P_{el} SUP	total
	W/(m³/s)	W/(m³/s)	m³/h	m³/h	pice	%	Mio. m³/h	MW/a	Mio. m³/h	MW/a	MW/a
2006	1.900	1.567	14.106	13.426	31.857	70,5	552,6	240,6	571,5	301,6	**542,2**
2007	1.905	1.545	13.212	14.834	30.952	70,5	502,9	215,9	613,5	324,7	**540,6**
2008	1.887	1.569	13.196	15.667	31.424	70,5	510,0	222,2	657,8	344,9	**567,1**
2009	1.867	1.630	10.847	15.127	25.295	70,5	337,4	152,7	511,3	265,2	**417,9**
2010	1.826	1.547	12.704	13.332	26.846	70,5	419,4	180,2	478,2	242,5	**422,7**
2011	1.791	1.507	13.820	14.028	29.567	75,0	472,4	197,7	520,9	259.2	**456,9**
2012	1.697	1.513	14.037	13.073	27.885	70,0	484,8	203,8	490,6	231,2	**435,0**
2013	1.636	1.382	14.732	14.422	22.793	75,0	388,2	149,0	412,9	187.6	**336,6**
2014	1.618	1.332	14.606	14.796	22.686	70.5	407.5	150.8	448.5	201.6	**352.3**

Installed electric power for AHU´s in NRB

P_{el} in NRB in germany

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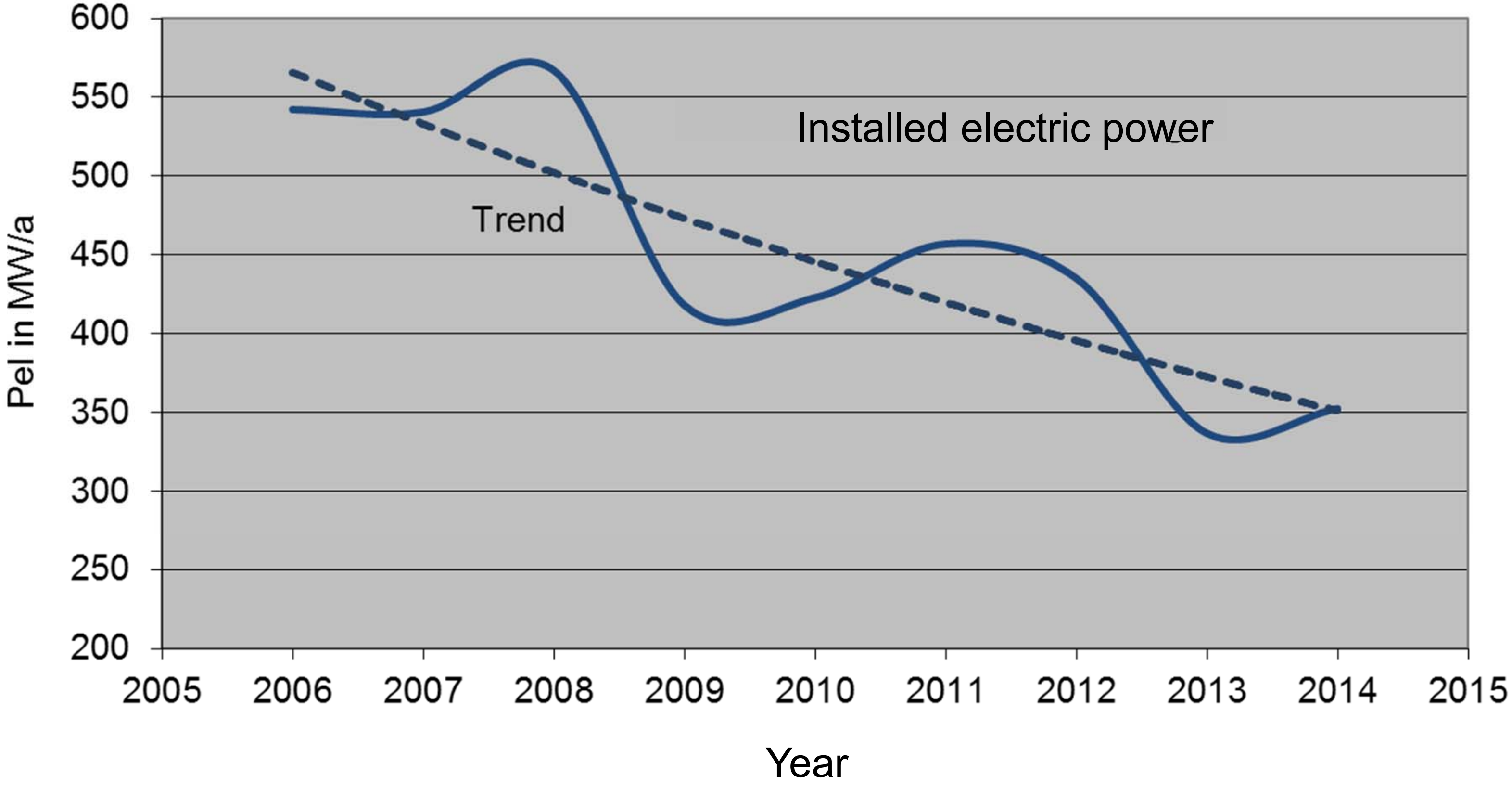
UCB-Study 2014 for



Development of new installed electric power P_{el} in NRB

Ventilation with heat recovery

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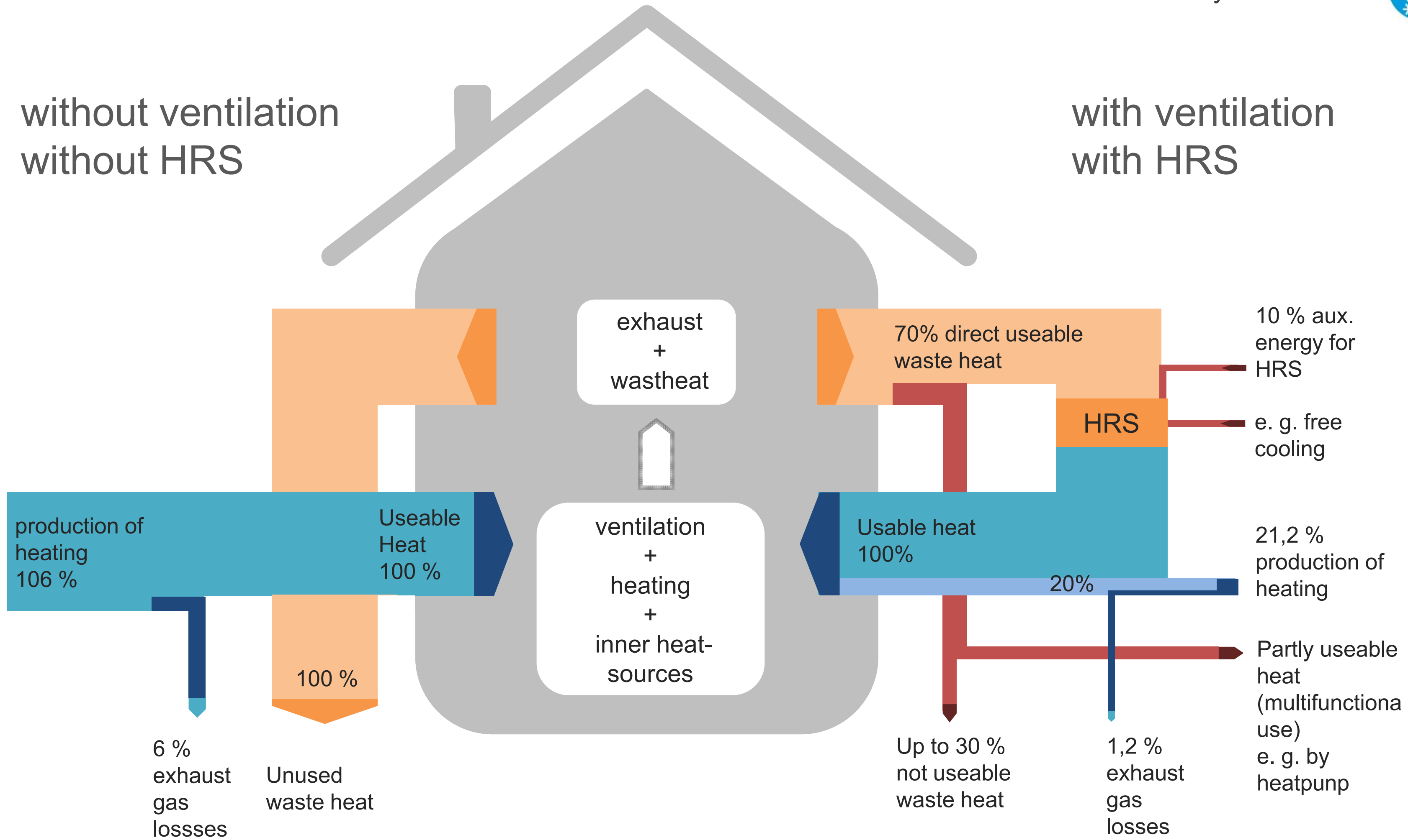
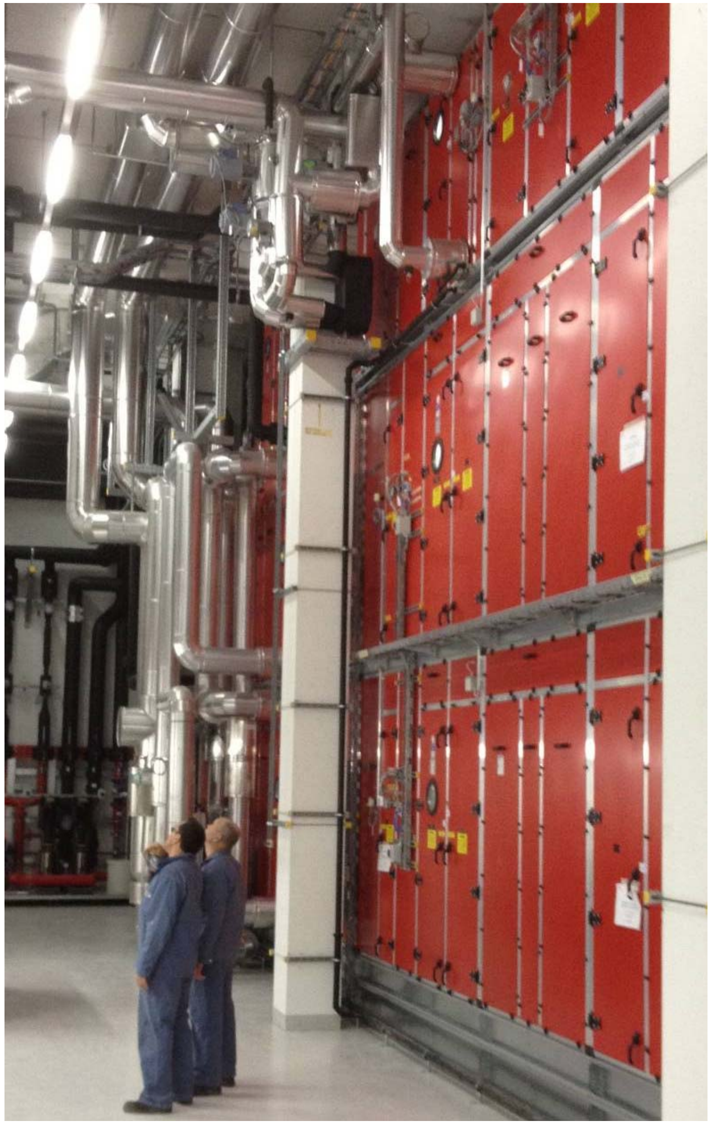
UCB-survey 2012 for



Ventilation in NRB



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