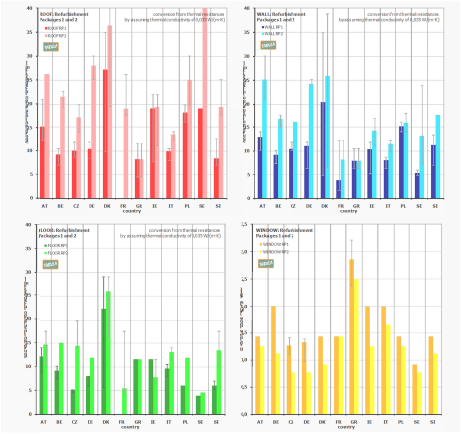
Typology Approach
for Building Stock
Energy Assessment

Evaluation of the TABULA Database

Comparison of Typical Buildings and Heat Supply Systems from 20 European Countries



– Work Report –

EPISCOPE

Energy Performance Indicator Tracking Schemes
for the Continuous Optimisation of Refurbishment
Processes in European Housing Stocks

EPISCOPE Project Team

December 2015

(Data version: April 2015)

www.episcope.eu

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Joint TABULA and EPISCOPE website: www.episcope.eu

Contents

1 Intention of the Analyses

During the European projects TABULA and EPISCOPE experts from 20 countries provided data of exemplary buildings and systems for showcase calculations representing different national building and system types. An evaluation of the data has been performed with the following intentions:

- **Make a comparison of energy related features of exemplary buildings from different countries:**
  Characteristics of the envelope areas, the thermal performance of construction elements, the typical and advanced insulation measures, and the supply system efficiency can be determined and compared between the countries.

- **Generate default values for rough estimations on supranational level:**
  In some cases components differ only slightly from country to country. Here the determination of averages seems an appropriate approach to deliver "common" values. These can be used as default numbers in case national values have not (yet) been determined. In the future this might be helpful especially for experts of countries which did not participate at the TABULA and EPISCOPE project. Also simplified supranational considerations could rely on the default values.

- **Contribute to a high data quality:**
  Data acquisition and transformation is prone to errors. Especially the determination of the thermal envelope area and the conditioned floor area of a building is problematic: Double counting or omission of areas, copy-paste errors, uncertainties as regards the correct position of the thermal envelope (e.g. in case of unheated spaces). The definition of key figures and the determination of their typical ranges and dependence of the main geometrical parameters may help in the future to flag implausible datasets. The knowledge about typical area relations may not only help to improve the data quality of the TABULA example building database but can also be useful in national EPC issuing.

The following data tables were used to collect this information:

Table 1: Analysed data sheets of the Excel workbook TABULA.xls

Sheet	Content
Tab.Building.Constr	national definition of construction elements + U-values
Tab.Building.Measure	national definition of insulation measures + thermal resistance
Tab.System.HG	heating system / generation
Tab.System.HS	heating system / storage
Tab.System.HD	heating system / distribution
Tab.System.HA	heating system / auxiliary energy
Tab.System.WG	domestic hot water system / generation
Tab.System.WS	domestic hot water system / storage
Tab.System.WD	domestic hot water system / distribution
Tab.System.WA	domestic hot water system / auxiliary energy
Tab.System.H	datasets of heating system types
Tab.System.W	datasets of domestic hot water system types
Tab.System.Vent	datasets of heating system types
Tab.System.EC	datasets of energy carrier specifications
Tab.Building	datasets of exemplary buildings
Calc.Building.Set	definition of variants and calculation of the energy need for heating
Calc.System.Set	definition of variants and calculation of the system efficiency

These sheets are part of the workbook TABULA.xlsm which was used as a database and programming template for the TABULA WebTool.[1]

The evaluation was performed in April 2015 and reflects the datasets at that time. 605 datasets of real buildings and 849 datasets of heat supply components are included.

The EPISCOPE project partners were asked in May 2015 to check the analyses and to adapt or correct datasets if necessary. In case of changes of datasets comments are given at the respective charts or tables of this work report. However, an analysis of the revised data has not been performed.

[1] More information about the common calculation procedure and the TABULA WebTool at: www.episcope.eu/building-typology/country/

2 Thermal Envelope Area

2.1 Analysed Quantities

The analyses of the thermal envelope areas of the example buildings are based on the following quantities (Sheet "Tab.Building"):

Table 2: Input quantities (TABULA datafields)

A_C_Ref	energy reference area (conditioned floor area, internal dimensions)	mandatory / for transformation from other area types see DATAMINE evaluation		m²
n_Storey	number of complete storeys	number of conditioned floors/storeys of the building (without attic storey, without cellar) (see below) If there is a completely conditioned underground storey it is not considered here (In this case there is a completely conditioned cellar, so cellar_cond=c, see below).		
Code_RoofType	type / inclination of the roof	TR	tilted roof, tilted >= 30°	
		FR	flat roof, tilted < 30°	
		UC	upper floor ceiling below unheated attic space	
Code_AtticCond	heating situation in the attic rooms (if available)	-	attic not existent (flat roof)	
		N	attic not conditioned, thermal envelope in the plain of the upper ceiling	
		P	attic partly conditioned	
		C	attic completely conditioned	
		NI *	attic not conditioned, thermal envelope in the plain of the roof area	
		PI *	attic partly conditioned, thermal envelope in the plain of the roof area	
Code_CellarCond	heating situation in the cellar rooms (if available)	-	cellar storey not existent	
		N	cellar storey not conditioned	
		P	cellar storey partly conditioned	
		C	completely conditioned	
		NI *	cellar storey not conditioned, cellar volume completely in thermal envelope	
		PI *	cellar storey partly conditioned, cellar volume completely in thermal envelope	
Code_AttachedNeighbours	neighbour situation / number of directly attached buildings	B_Alone	stand-alone building (detached)	
		B_N1	1 neighbour (semi-detached)	
		B_N2	2 neighbours (terraced)	
A_Roof_1	surface area (external dimensions)	element type roof 1		m²
A_Roof_2	surface area (external dimensions)	element type roof 2		m²
A_Wall_1	surface area (external dimensions)	element type wall 1		m²
A_Wall_2	surface area (external dimensions)	element type wall 2		m²
A_Wall_3	surface area (external dimensions)	element type wall 3		m²
A_Floor_1	surface area (external dimensions)	element type floor 1		m²
A_Floor_2	surface area (external dimensions)	element type floor 2		m²
A_Window_1	surface area, including frame	element type window 1		m²
A_Window_2	surface area, including frame	element type window 2		m²
A_Door_1	surface area, including frame	element type door 1		m²

*) For simplification reasons the cases Code_AtticCond and Code_CellarCond were not considered in the analyses (only a small number of buildings in the database is concerned).

During the analyses the following auxiliary quantities are used:

Table 3: Auxiliary quantities

f_AtticCond / f_CellarCond	heated fraction of the available space	values for cases of Code_AtticCond / Code_CellarCond *: "-": 0 "C": 1 "P": 0,5 "N": 0	
n_Storey_eff	effective number of storeys including conditioned areas in cellar and attic	= n_storey + f_CellarCond + 0,75 * f_attic_cond	
A_C_Storey	conditioned floor area per storey	= A_C_Ref / n_Storey_eff	m²
A_Roof	A_Roof_1 + A_Roof_2		m²
A_Wall	A_Wall_1 + A_Wall_2 + A_Wall_3		m²
A_Window	A_Window_1 + A_Window_2 + A_Door_1		m²
A_Floor	A_Floor_1 + A_Floor_2		m²

*) For simplification reasons the cases Code_AtticCond and Code_CellarCond were not considered in the analyses (only a small number of buildings in the database is concerned).

2.2 Floor Area Related Averages

The following table shows the conditioned floor areas and the thermal envelope areas of the example buildings from the different countries, averaged over all construction year classes and differentiated by building size class.

In addition the envelope areas per conditioned floor area were determined for each envelope type. These indicators can be useful for a first quality assurance since they are usually positioned in a certain range. Apart from that, they also can serve as a preliminary basis for the definition of synthetical average buildings for the energy assessment of building stocks (see [TABULA NatBal 2012]) – as far as no deeper empirical investigation of the building stock is available.

Table 4: **Average thermal envelope areas of the example buildings per country and building size class and derived floor area related values** (data source: "Tab.Building")

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	Common	
SFH (single family houses)																						
A_C_Ref	145	220	172	133	112	173	127	248	106	147	162	112	123	154	163	214	136	128	121	201	155	m²
average thermal envelope area																						
A_Roof	109	158	118	151	79	133	137	94	78	92	123	96	110	98	100	133	88	84	143	129	113	m²
A_Window	26	49	36	44	22	32	26	29	18	36	31	16	23	19	35	36	29	27	25	46	30	m²
A_Wall	229	207	183	303	152	182	122	252	155	161	191	128	136	226	144	226	113	180	200	200	184	m²
A_Floor	96	135	120	149	72	100	120	91	76	92	110	91	109	89	74	117	79	89	143	127	104	m²
average thermal envelope area related to the conditioned floor area																						
A_Roof / A_C_Ref	0,77	0,72	0,81	1,15	0,75	0,81	1,07	0,55	0,78	0,63	0,85	0,84	0,92	0,64	0,63	0,63	0,66	0,85	1,18	0,75	0,80	m²/m²
A_Window / A_C_Ref	0,18	0,22	0,21	0,30	0,19	0,19	0,20	0,15	0,17	0,25	0,19	0,14	0,18	0,13	0,21	0,17	0,21	0,19	0,21	0,24	0,20	m²/m²
A_Wall / A_C_Ref	1,59	0,94	1,31	2,40	1,38	1,10	0,96	1,30	1,51	1,10	1,19	1,15	1,12	1,51	0,87	1,09	0,87	1,49	1,68	0,97	1,28	m²/m²
A_Floor / A_C_Ref	0,68	0,62	0,86	1,13	0,67	0,60	0,94	0,55	0,75	0,63	0,76	0,80	0,92	0,57	0,47	0,57	0,59	0,87	1,18	0,72	0,74	m²/m²
TH (terraced houses)																						
A_C_Ref	200	168	218	119	106	137	102	177	102	90	-	-	100	114	124	260	285	121	-	178	153	m²
average thermal envelope area																						
A_Roof	126	74	173	70	70	71	80	84	72	50	-	-	60	73	64	161	201	117	-	116	98	m²
A_Window	30	31	44	35	14	25	21	31	16	21	-	-	18	14	23	44	59	22	-	30	28	m²
A_Wall	259	91	296	326	79	99	49	130	93	84	-	-	78	96	42	246	242	193	-	126	149	m²
A_Floor	117	66	166	69	70	62	61	83	70	50	-	-	60	67	51	152	169	115	-	113	91	m²
average thermal envelope area related to the conditioned floor area																						
A_Roof / A_C_Ref	0,65	0,44	0,84	0,59	0,67	0,54	0,80	0,54	0,75	0,55	-	-	0,61	0,64	0,52	0,62	0,71	1,04	-	0,69	0,66	m²/m²
A_Window / A_C_Ref	0,16	0,18	0,22	0,30	0,13	0,19	0,20	0,20	0,16	0,23	-	-	0,18	0,13	0,18	0,17	0,21	0,19	-	0,16	0,19	m²/m²
A_Wall / A_C_Ref	1,33	0,54	1,57	2,78	0,72	0,68	0,46	0,88	1,02	0,93	-	-	0,76	0,83	0,35	1,01	0,86	1,71	-	0,70	1,01	m²/m²
A_Floor / A_C_Ref	0,57	0,39	0,81	0,59	0,67	0,47	0,60	0,52	0,73	0,55	-	-	0,61	0,59	0,41	0,58	0,60	1,03	-	0,67	0,61	m²/m²
MFH (multi-family houses)																						
A_C_Ref	418	1613	495	1501	681	1239	-	1022	481	653	884	644	-	884	2618	-	2186	1059	1207	1362	1115	m²
average thermal envelope area																						
A_Roof	197	443	229	429	233	392	-	296	175	227	231	226	-	357	468	-	602	279	470	316	328	m²
A_Window	62	717	103	257	137	215	-	137	91	115	202	97	-	116	554	-	469	193	180	188	226	m²
A_Wall	426	786	598	1922	532	907	-	913	417	371	690	668	-	996	995	-	1509	1177	800	777	852	m²
A_Floor	193	429	206	429	233	385	-	257	177	227	216	215	-	357	451	-	602	267	470	368	323	m²
average thermal envelope area related to the conditioned floor area																						
A_Roof / A_C_Ref	0,48	0,26	0,62	0,30	0,42	0,35	-	0,29	0,41	0,35	0,27	0,36	-	0,41	0,19	-	0,29	0,27	0,39	0,25	0,35	m²/m²
A_Window / A_C_Ref	0,15	0,43	0,26	0,16	0,20	0,17	-	0,14	0,21	0,18	0,22	0,15	-	0,13	0,21	-	0,22	0,18	0,15	0,15	0,19	m²/m²
A_Wall / A_C_Ref	1,09	0,45	1,55	1,32	0,93	0,77	-	0,89	0,91	0,58	0,82	0,98	-	1,15	0,41	-	0,74	1,18	0,66	0,67	0,89	m²/m²
A_Floor / A_C_Ref	0,48	0,25	0,57	0,30	0,42	0,34	-	0,23	0,40	0,35	0,26	0,33	-	0,41	0,19	-	0,29	0,26	0,39	0,32	0,34	m²/m²
AB (apartment blocks)																						
A_C_Ref	971	11700	2200	-	3026	2556	1945	2582	2742	3921	-	1702	1521	2201	2886	1789	6384	1204	-	6042	3257	m²
average thermal envelope area																						
A_Roof	377	660	587	-	460	473	485	344	612	379	-	340	450	490	601	585	780	346	-	1023	529	m²
A_Window	160	4371	540	-	604	397	478	336	473	797	-	359	225	326	618	306	1614	244	-	1154	765	m²
A_Wall	801	3512	1371	-	1389	1656	931	1387	1714	1990	-	1197	859	2354	1069	949	3756	1290	-	2618	1697	m²
A_Floor	376	660	499	-	460	463	455	359	598	379	-	340	429	473	567	560	674	321	-	863	498	m²
average thermal envelope area related to the conditioned floor area																						
A_Roof / A_C_Ref	0,39	0,09	0,28	-	0,21	0,20	0,36	0,15	0,23	0,10	-	0,20	0,32	0,23	0,23	0,34	0,12	0,29	-	0,14	0,23	m²/m²
A_Window / A_C_Ref	0,17	0,40	0,24	-	0,19	0,16	0,23	0,12	0,18	0,20	-	0,21	0,16	0,15	0,21	0,17	0,25	0,21	-	0,21	0,20	m²/m²
A_Wall / A_C_Ref	0,83	0,30	0,70	-	0,60	0,64	0,61	0,56	0,71	0,51	-	0,70	0,64	1,07	0,41	0,54	0,62	1,09	-	0,56	0,65	m²/m²
A_Floor / A_C_Ref	0,39	0,09	0,23	-	0,21	0,19	0,32	0,14	0,22	0,10	-	0,20	0,30	0,22	0,22	0,32	0,10	0,27	-	0,13	0,22	m²/m²

2.3 Dependence on the Basic Geometrical Parameters

During the first implementation of this analyses [TABULA DB Eval 2012] an estimation procedure had been derived supplying the typical thermal envelope area of a building with given basic geometrical parameters like conditioned floor area, number of attached neighbour buildings, number of storeys as well as type and heating situation of attic and cellar. This “thermal envelope estimation procedure” is now included in the TABULA.xlsm workbook for making a plausibility control of the supplied thermal envelope areas.

Apart from plausibility checks during data intake the estimation procedure could also be used for the rough energy assessment of large housing portfolios.

In the following a similar analysis of the correlation of the thermal envelope areas with the main geometrical parameters is reported and the prediction quality of the parameters of the existing procedure is assessed for the now more extended database.

The general assumption of the envelope estimation procedure is a linear dependency of

- window and façade[2] areas on the conditioned floor area of the whole building;
- floor and roof areas on the conditioned floor area of a (complete) storey.

In case of conditioned cellar or attic areas the number of complete storeys has been supplemented by a fraction representing the heated area in these spaces:

- supplement of 1.0 for a completely and 0.5 for a partly conditioned cellar.
- supplement of 0.7 for a completely and 0.5*0.7=0.35 partly conditioned attic.

A one-storey single-family house with a completely heated attic would for example be considered as a building with 1.7 effective storeys.

The "reference area per effective storey" used in the charts below is the TABULA reference floor area $A_{C,ref}$ divided by the number of effective storeys, as defined above.

In order to exclude very implausible values from the analyses the criteria listed in

[2] The term “façade area” will in the following be used for the total surface of walls, windows and doors.

Table 5 were applied. They are based on geometrical considerations: For example the area of a flat roof (based on external dimensions)[3] must be larger than the conditioned floor area of a storey (based on internal dimensions)[3]. By considering a minimum fraction of about 10% for the wall footprint the lower limit would be 1,1.

[3] according to the TABULA conventions

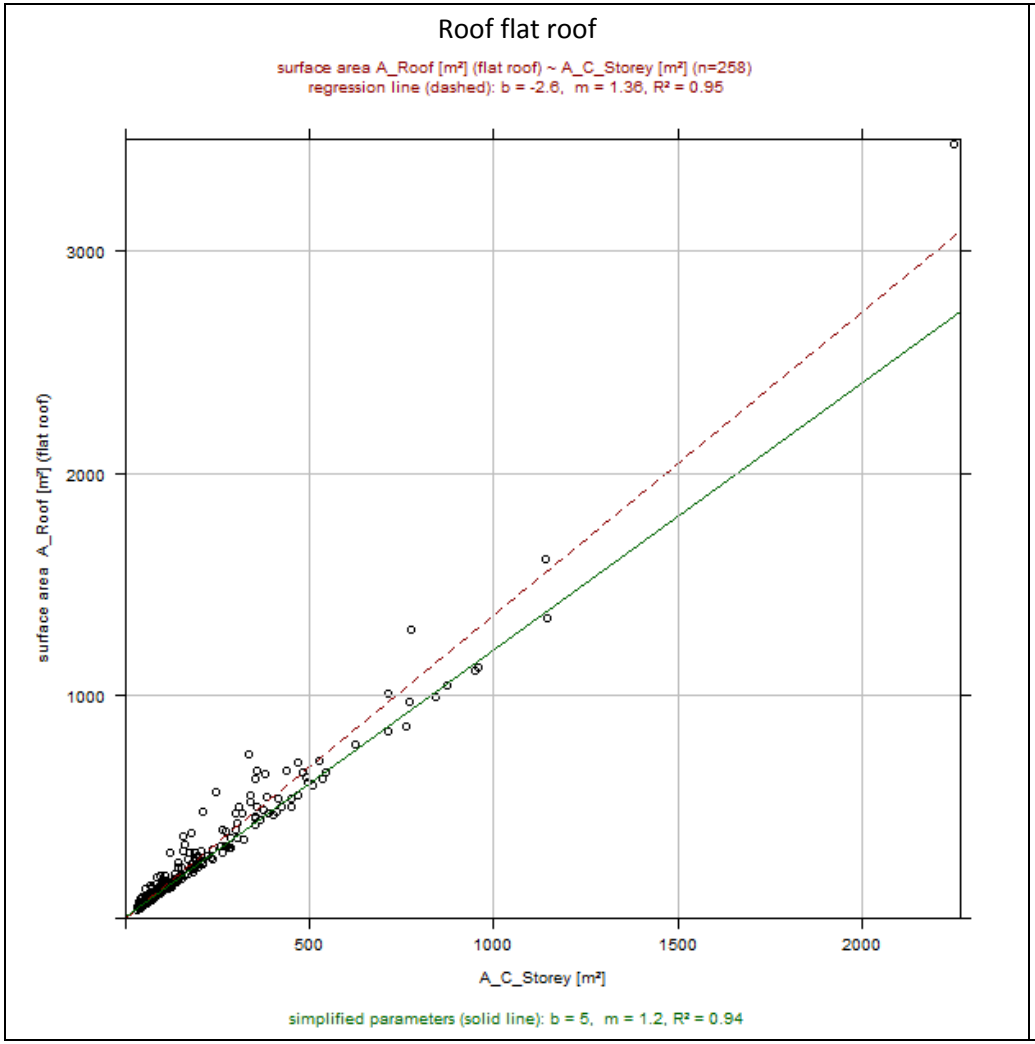
Table 5: Criteria for plausible area relations

	Minimum		Maximum
A_Wall / A_C_Ref	> 0,2		< 4
A_Window / A_C_Ref	> 0,05		< 0,5
A_Facade / A_C_Ref	> 0,2		< 5
	flat roof or attic not conditioned	attic partly or fully conditioned	
A_Roof / A_C_Storey	> 1,1	> 1,2	< 4
A_Floor / A_C_Storey	> 1,1	> 1,0	< 2

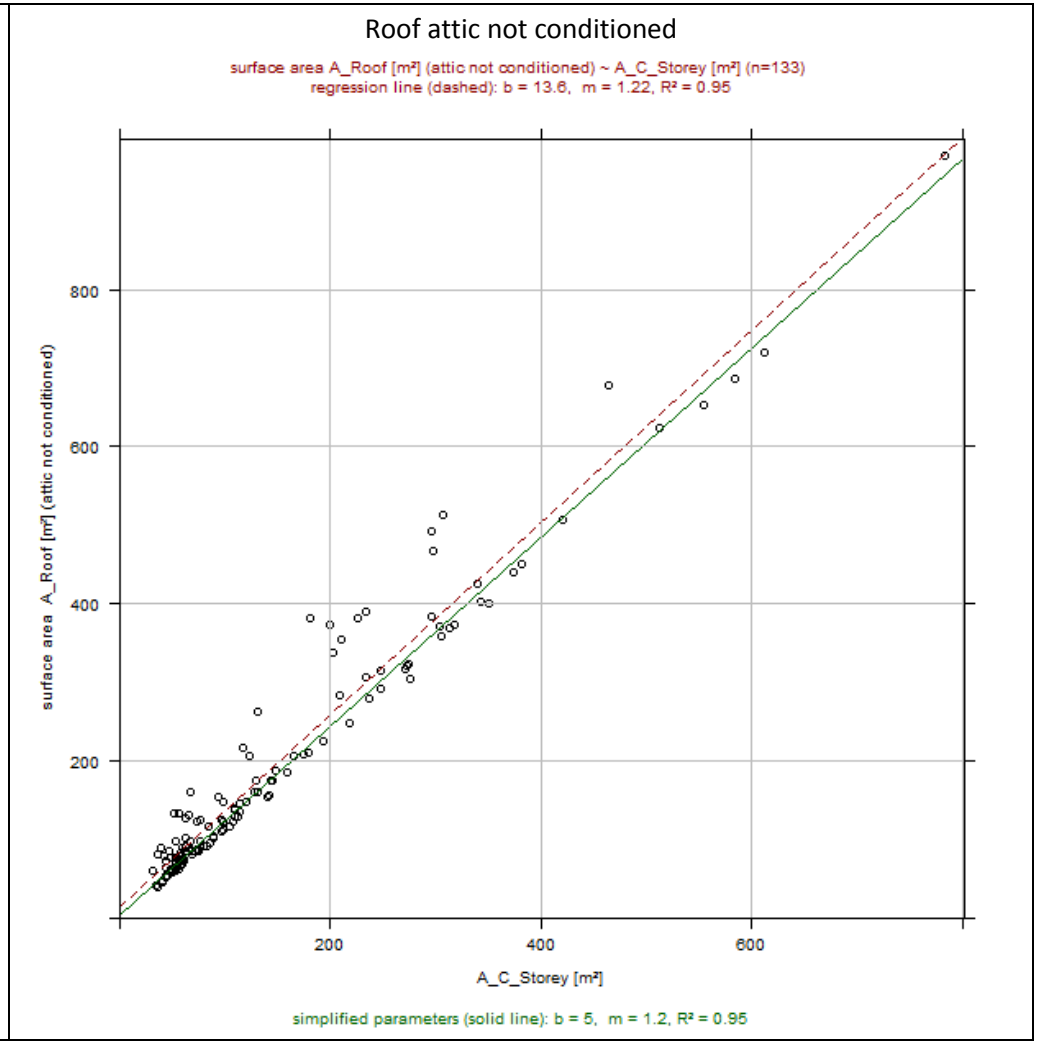
The linear regression analysis was performed by applying the software "R". In Appendix A a documentation of the detailed analyses can be found. The following charts show the main results:

Figure 1 (4 charts): Results of the regression analysis for the envelope type roof / upper ceiling

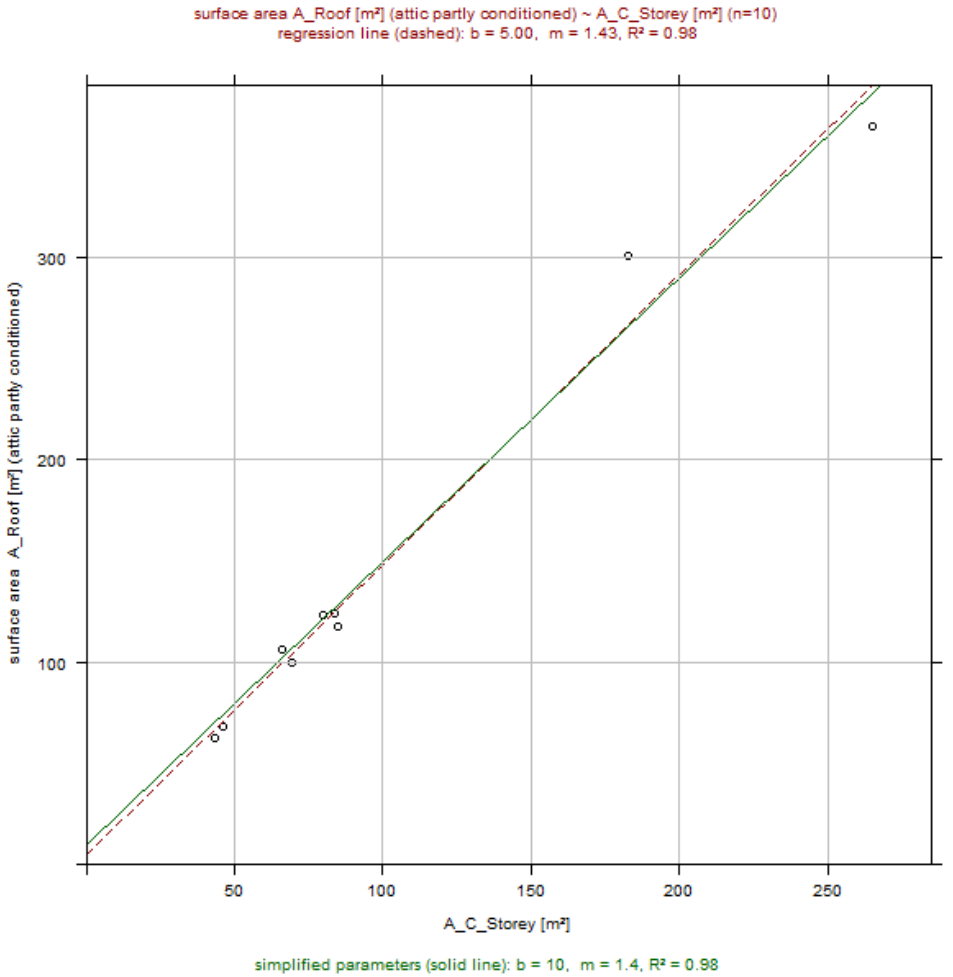
Roof flat roof



Roof attic not conditioned



Roof attic partly conditioned



(number of dasets not sufficient)

Roof attic completely conditioned

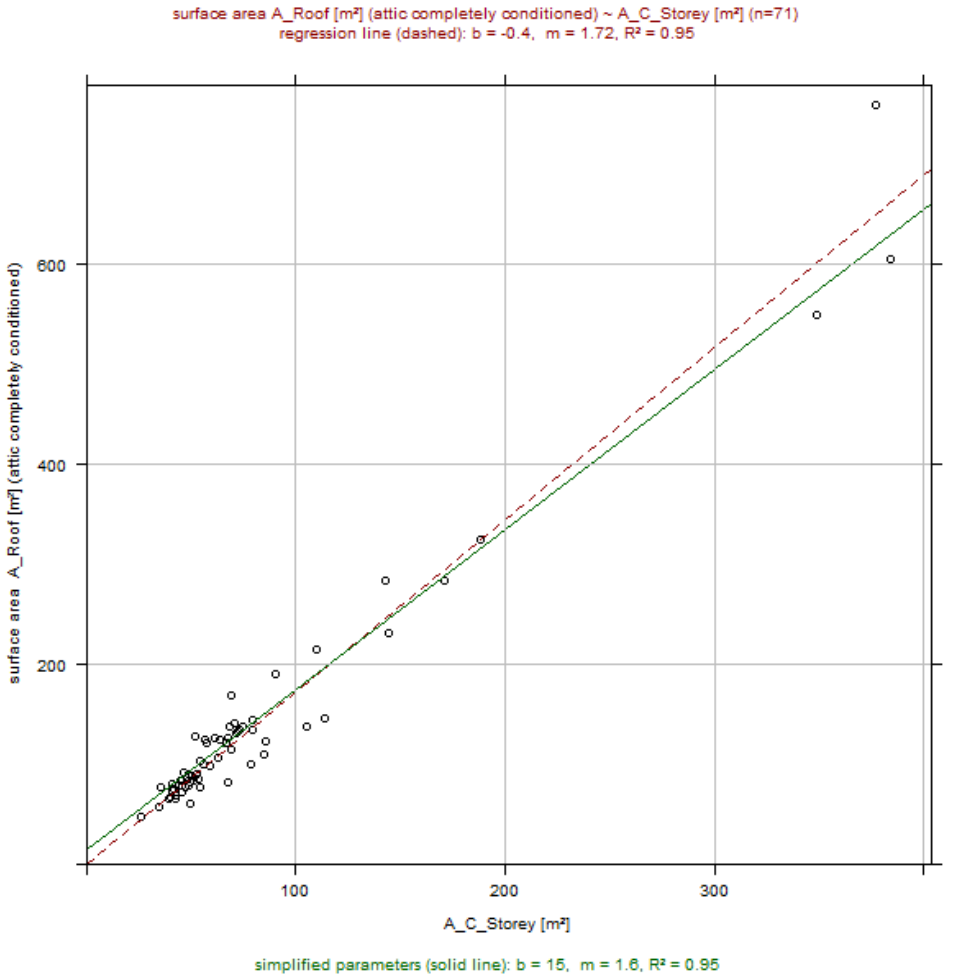
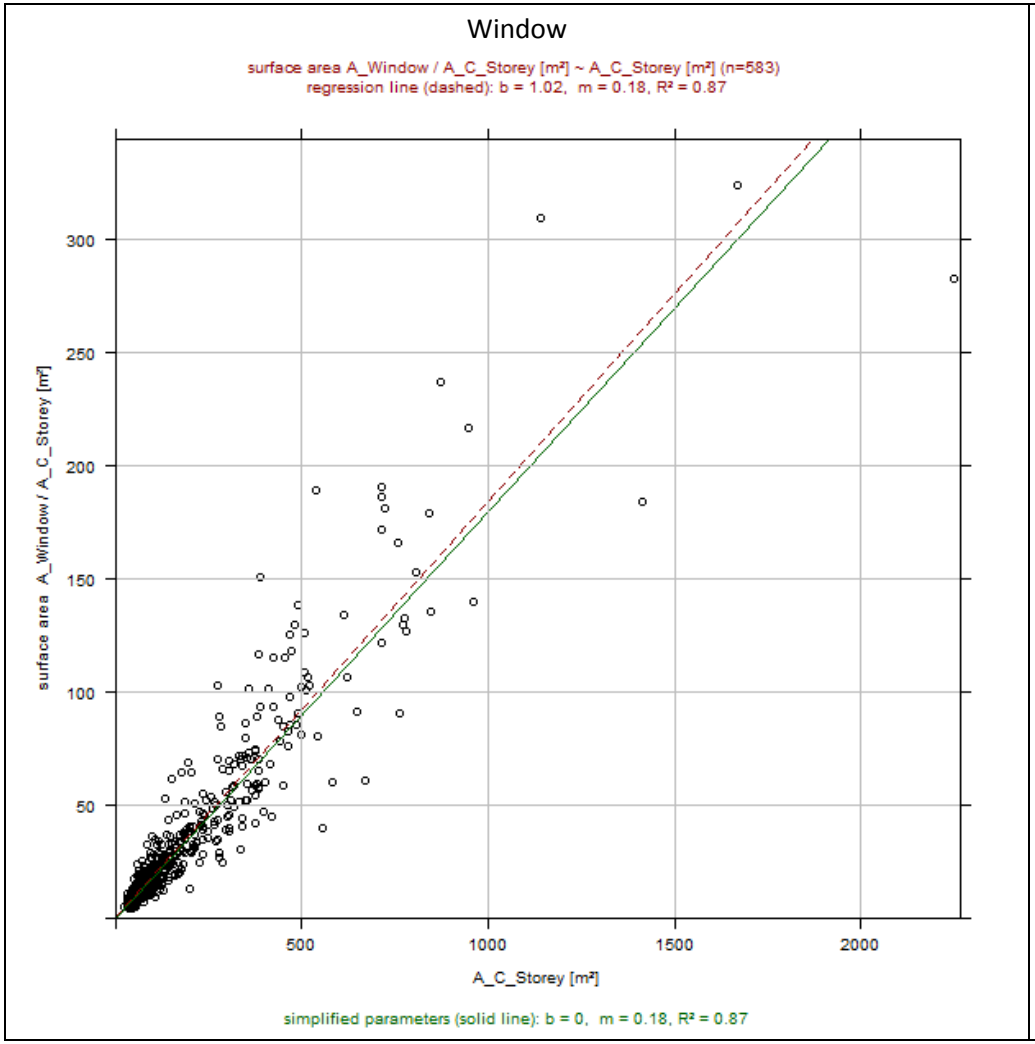
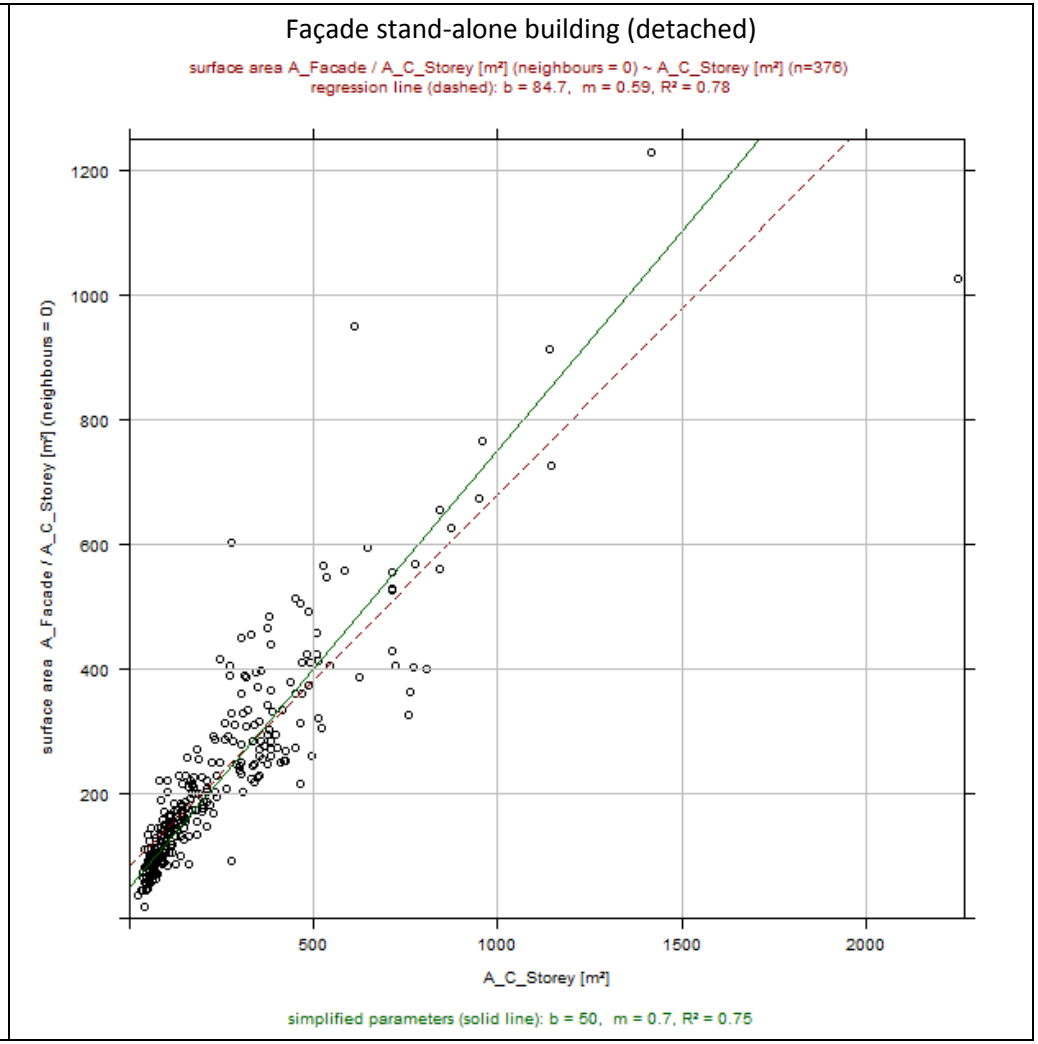


Figure 2 (4 charts): Results of the regression analysis for the envelope types window and façade

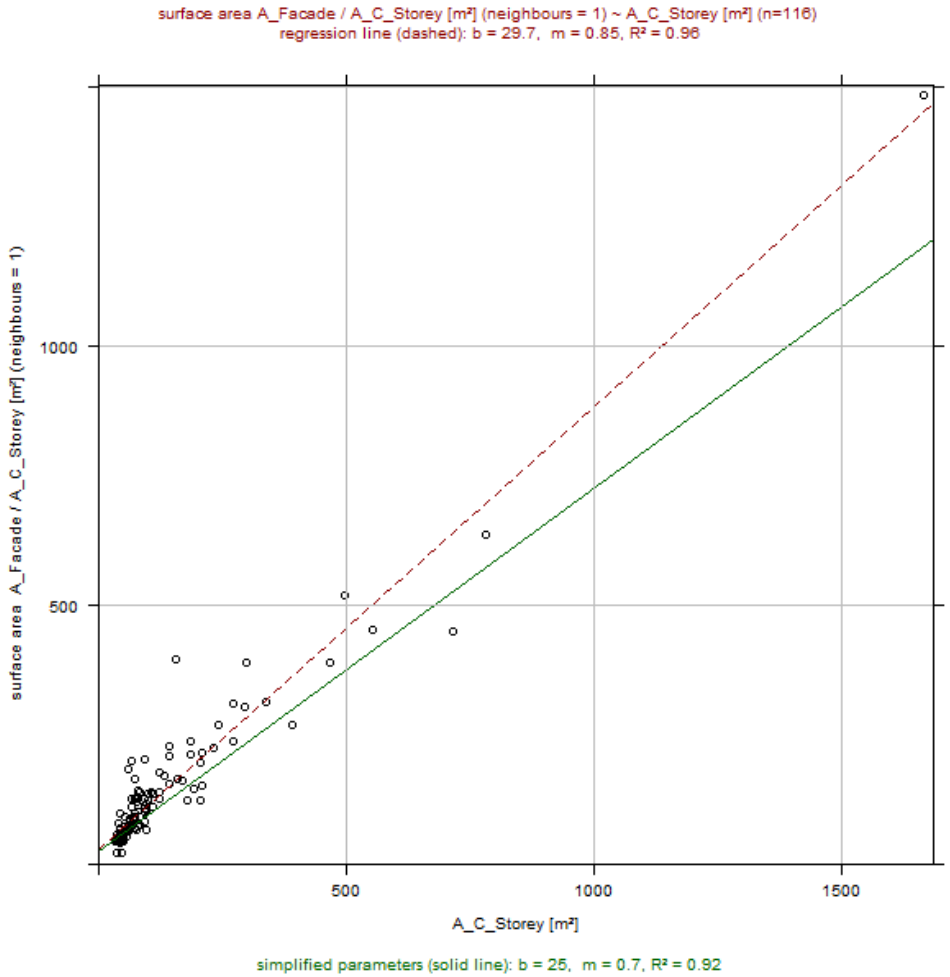
Window



Façade stand-alone building (detached)



Façade 1 neighbour (semi-detached)



Façade 2 neighbours (terraced)

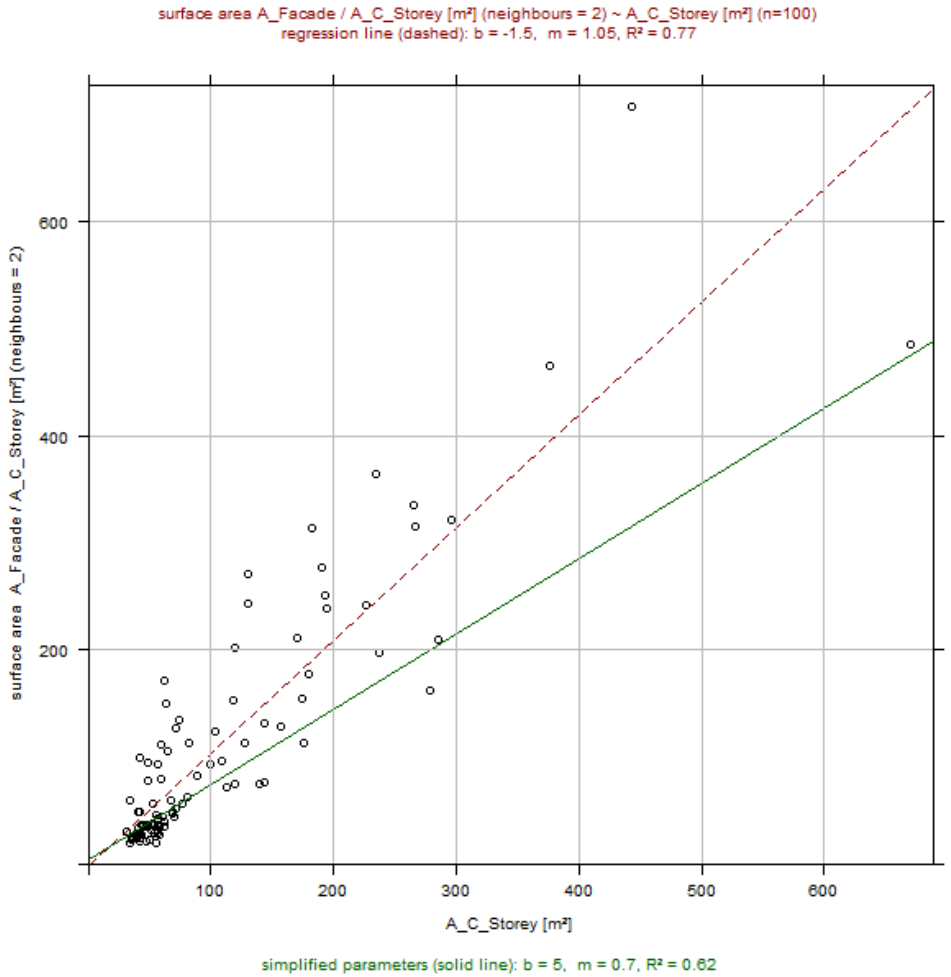


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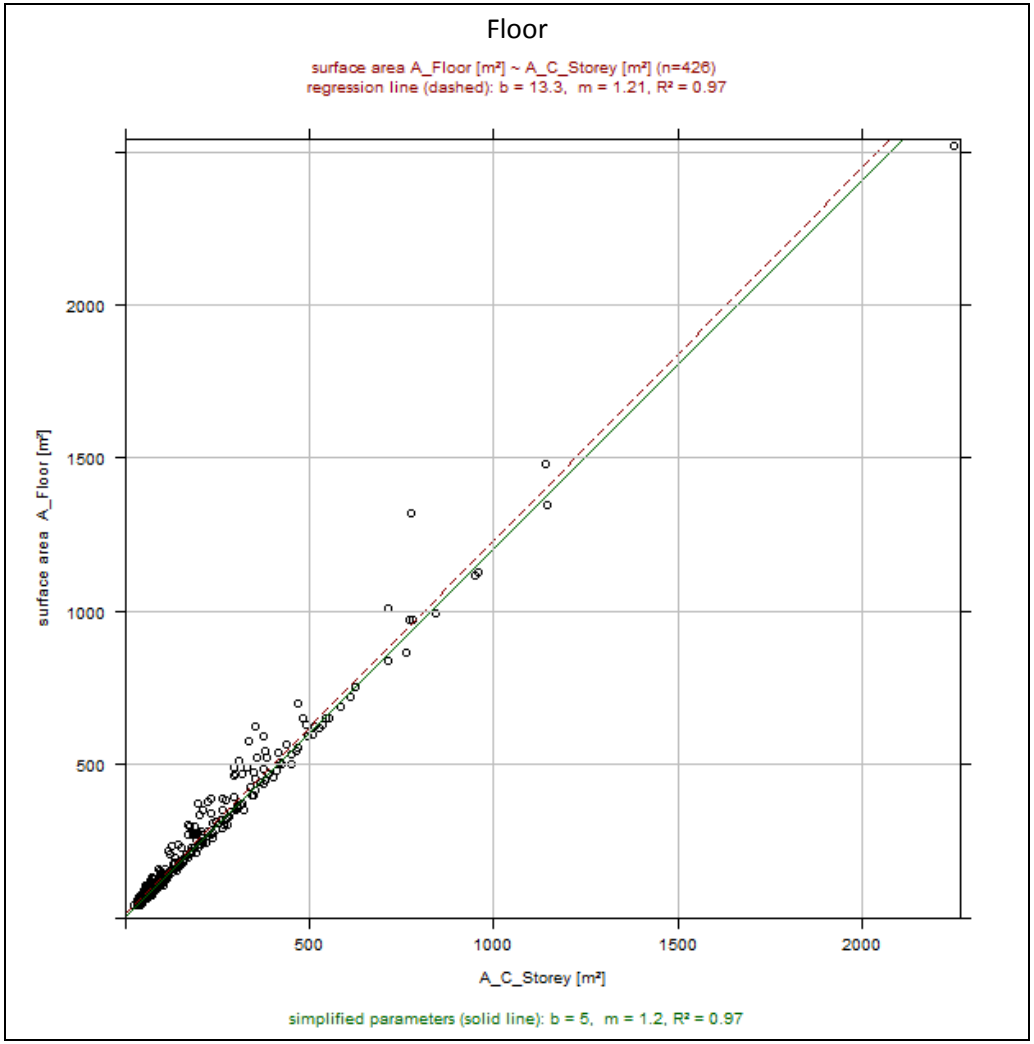
Figure 3: Results of the regression analysis for the envelope type floor



10-04-2015

2.4 Overview of estimation parameters

The parameters of the regression lines are cited in the headings of the above shown charts.

In order to arrive at a simple estimation procedure rough numbers were assumed in [TABULA DB Eval 2012] on the basis of the findings which take advantage of the similarities of dependencies. These ball park figures were again tested for the extended database as regards the coefficient of determination R^2.

It turns out that the assumed lines approximate the real data points nearly as well as the results of the regression analysis.

The values of intercept, slope and R^2 of the simplified prediction lines are mentioned in the footer of each chart. The following table gives a summary:

Table 6: Intercepts (b) and slopes (m) of the simplified model

Envelope type	Independent variable	Specification	b [m²]	m [-]
Roof	A_C_Storey	flat roof (no attic)	5	1.2
		attic not conditioned	5	1.2
		attic partly conditioned	10	1.4
		attic completely conditioned	15	1.6
Window	A_C_Ref		0	0.18
Façade	A_C_Ref	0 neighbours	50	0.7
		1 neighbours	25	0.7
		2 neighbours	5	0.7
Floor	A_C_Storey		5	1.2

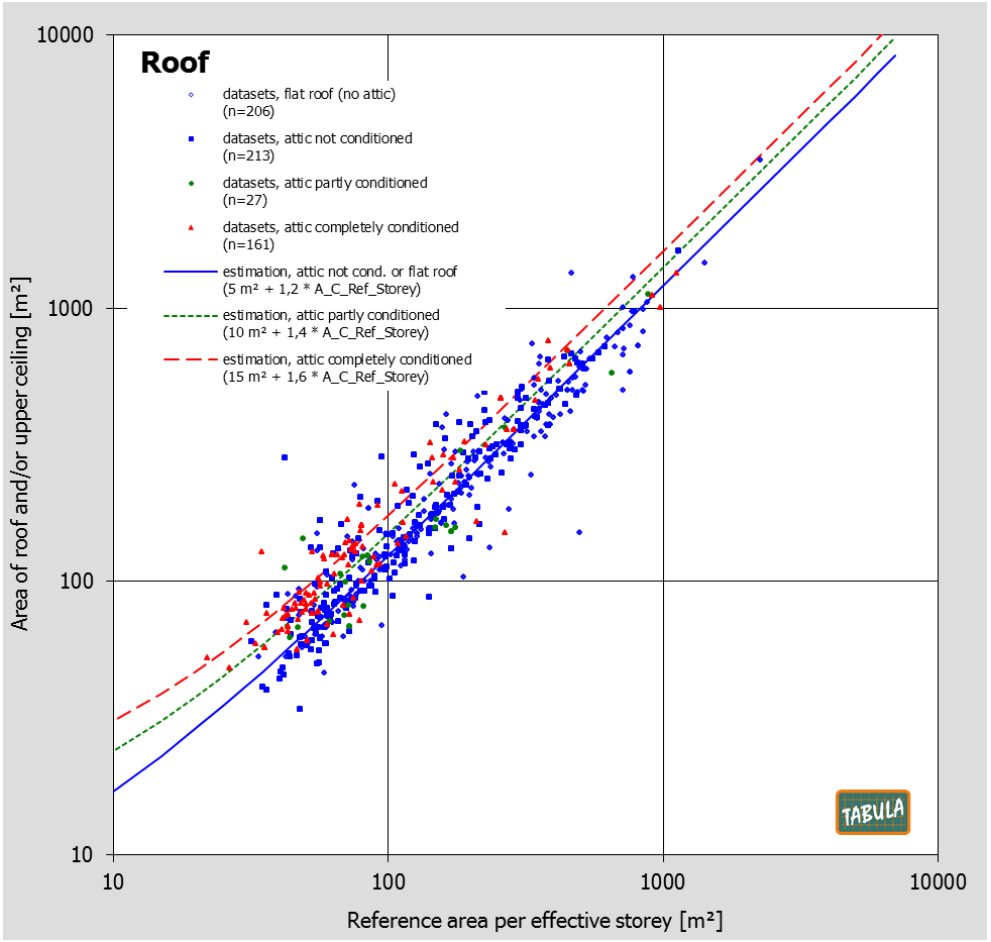
The charts of Figure 4 illustrate how the simplified model lines are approximating the data points. Logarithmic scales are used for both axes in order to make the dependence also visible for smaller buildings.[4]

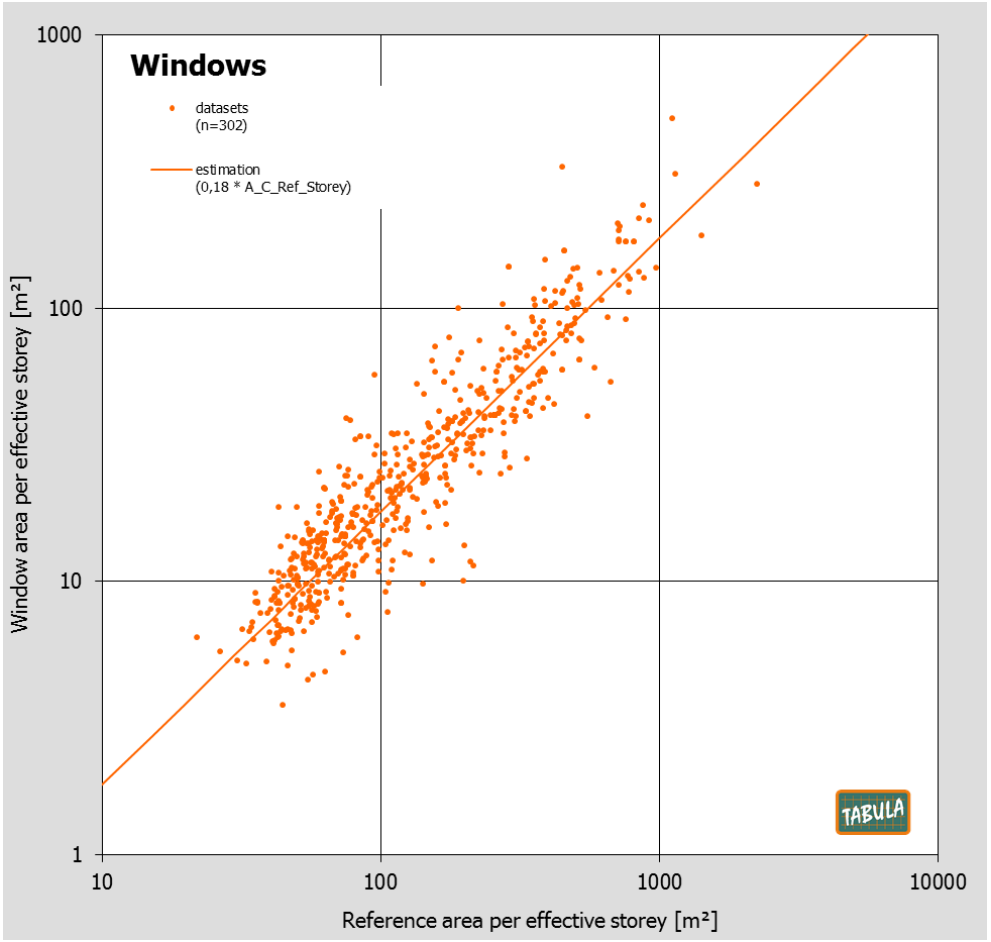
The charts of Figure 5 shows the frequencies of relative deviations between exact envelope area and estimated envelope area for the four envelope categories. In Figure 6 the accordance between the total envelope areas are shown. For 40% of the buildings the deviations of the total envelope area entered into the database lies within +/- 0.1 of the estimated value, for 80% of the buildings within +/- 0.3. These deviations are quite acceptable and the envelope area estimation procedure seems to be an appropriate instrument for plausibility controls.

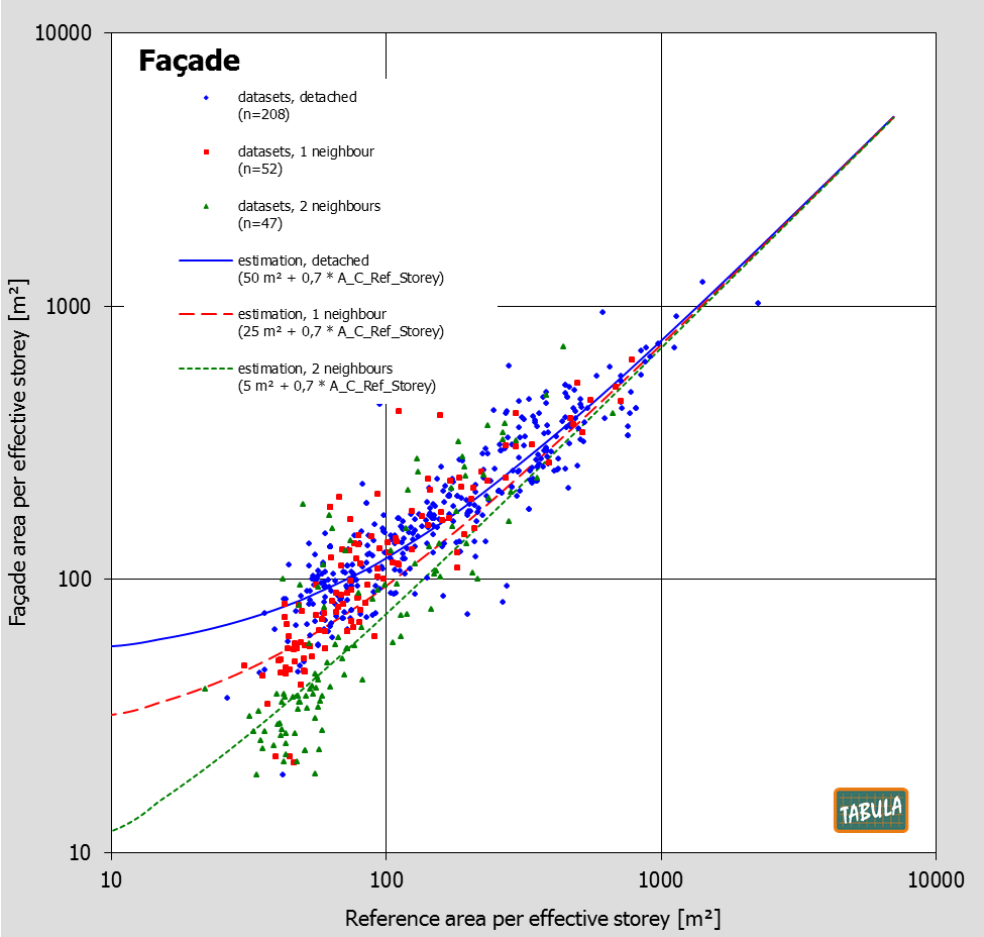
Furthermore it must be pointed out that no relevant systematic deviations could be found. This means that the procedure and its parameters seem to be well adapted for estimating the envelope area of larger building stock subsets with different geometrical features.

[4] On double logarithmic charts straight lines appear curved (with exception of the bisecting line).

Figure 4 (4 charts): Envelope surface area - data points and simplified model lines (double-logarithmic plots)






Façade
datasets, detached
(n=208)
datasets, 1 neighbour
(n=52)
datasets, 2 neighbours
(n=47)
estimation, detached
(50 m² + 0,7 * A_C_Ref_Storey)
estimation, 1 neighbour
(25 m² + 0,7 * A_C_Ref_Storey)
estimation, 2 neighbours
(5 m² + 0,7 * A_C_Ref_Storey)
Façade area per effective storey [m²]
Reference area per effective storey [m²]
10
100
1000
10000
TABULA

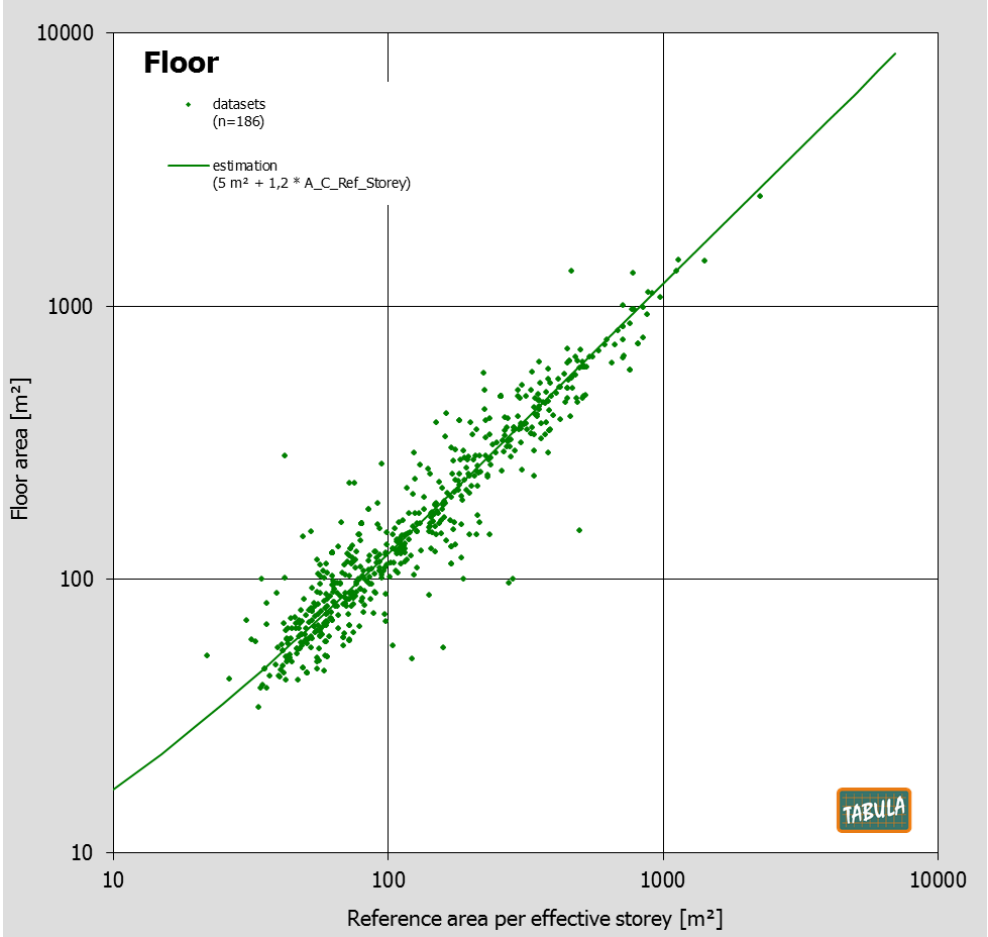
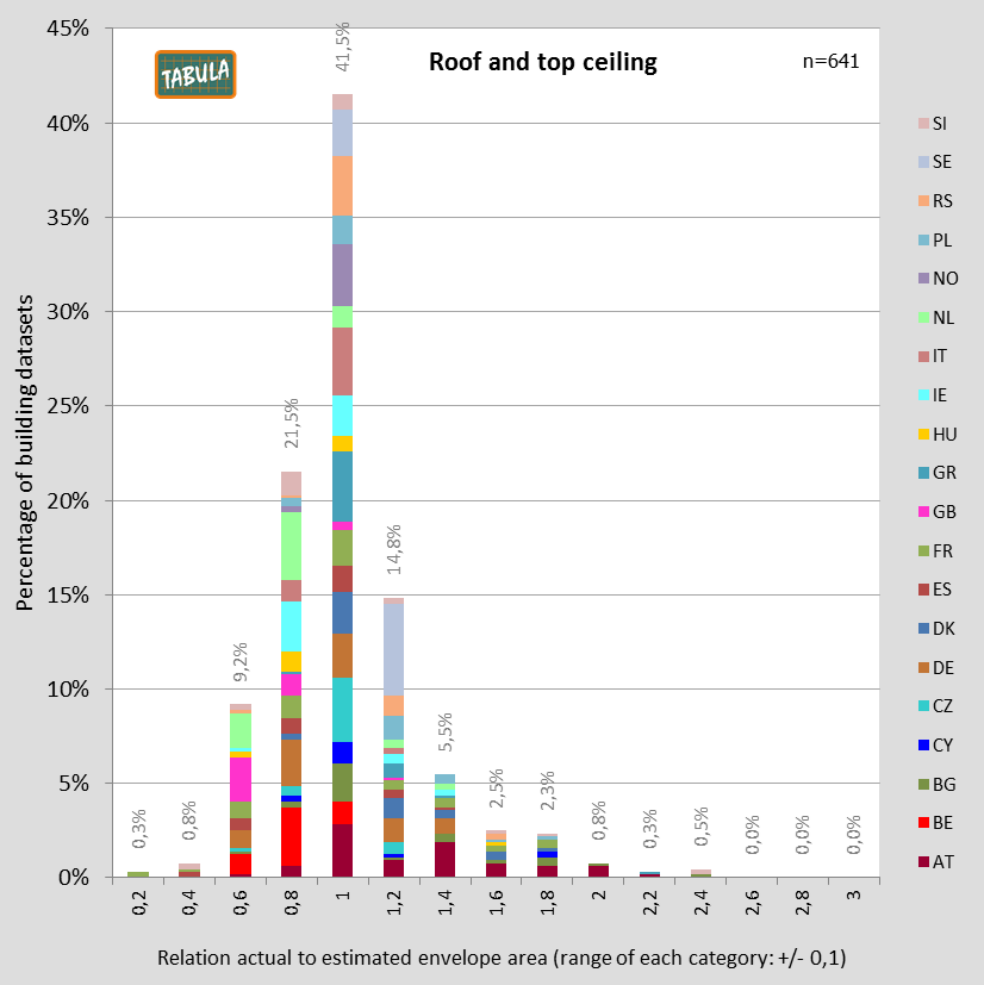
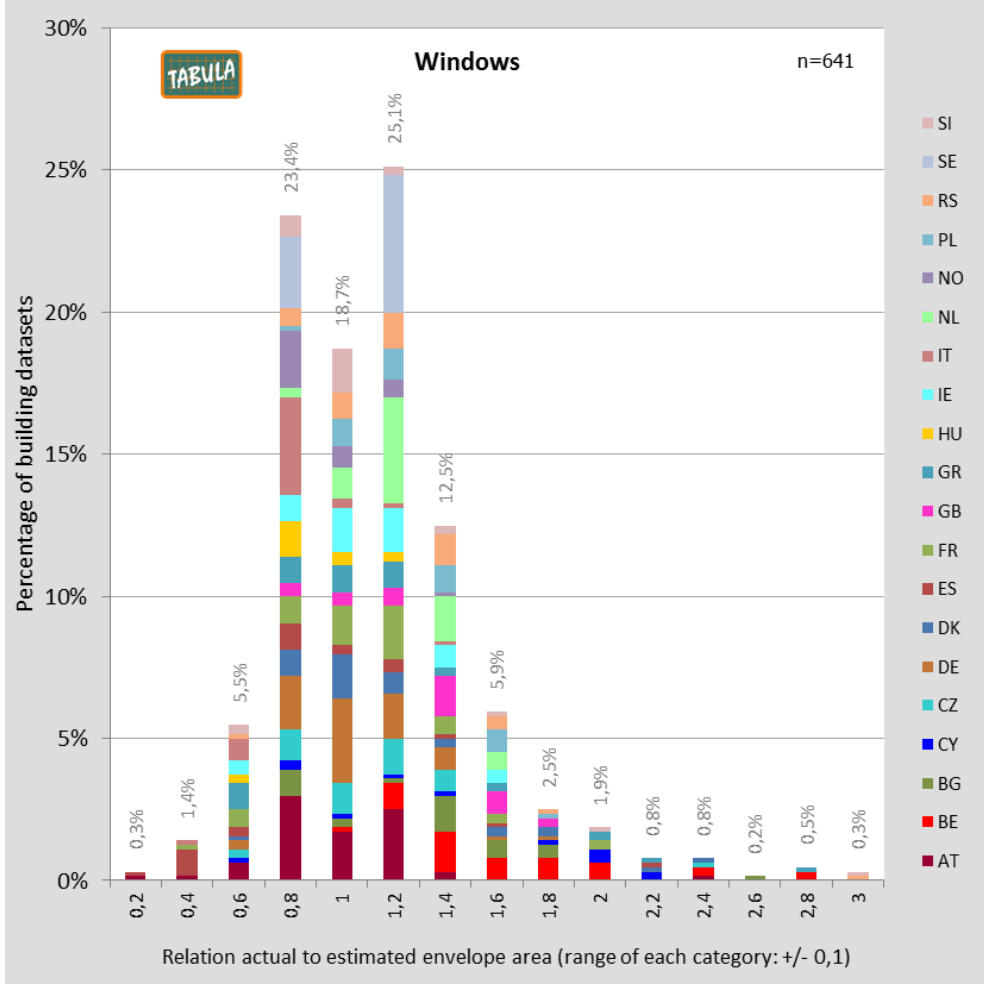
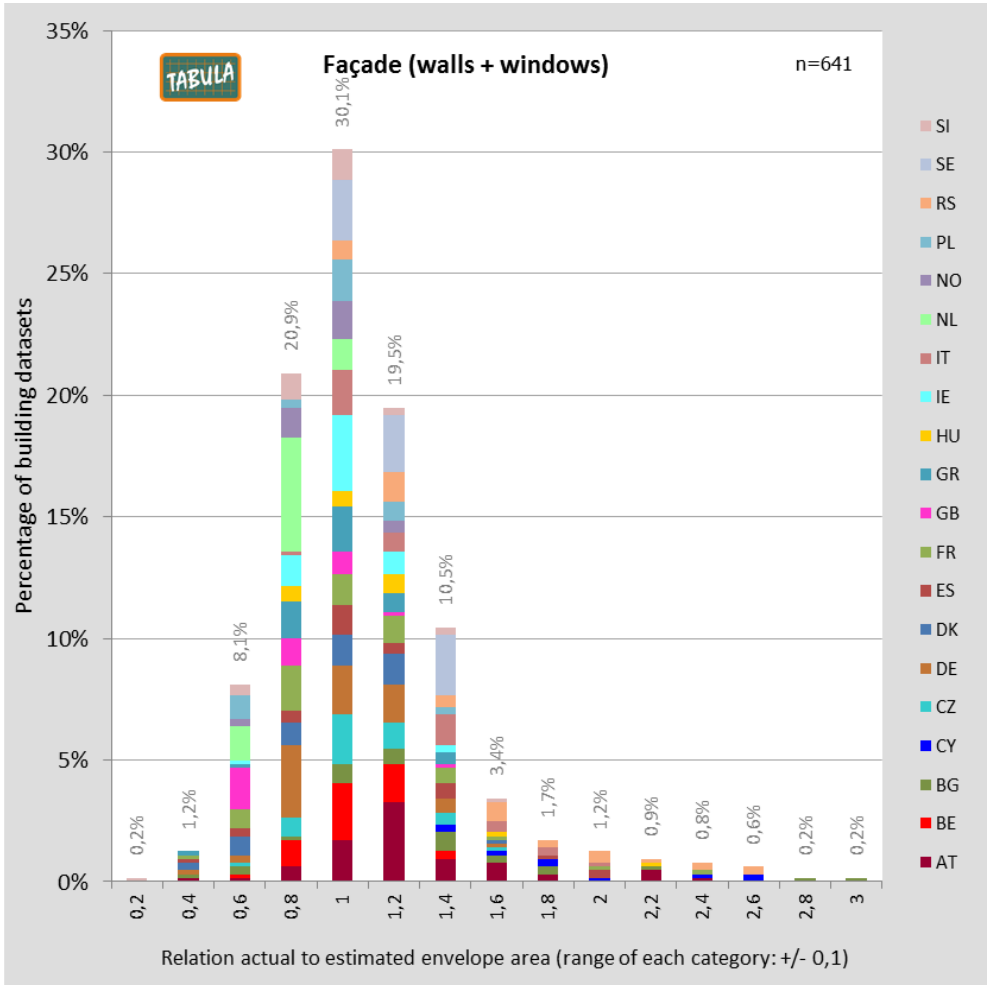
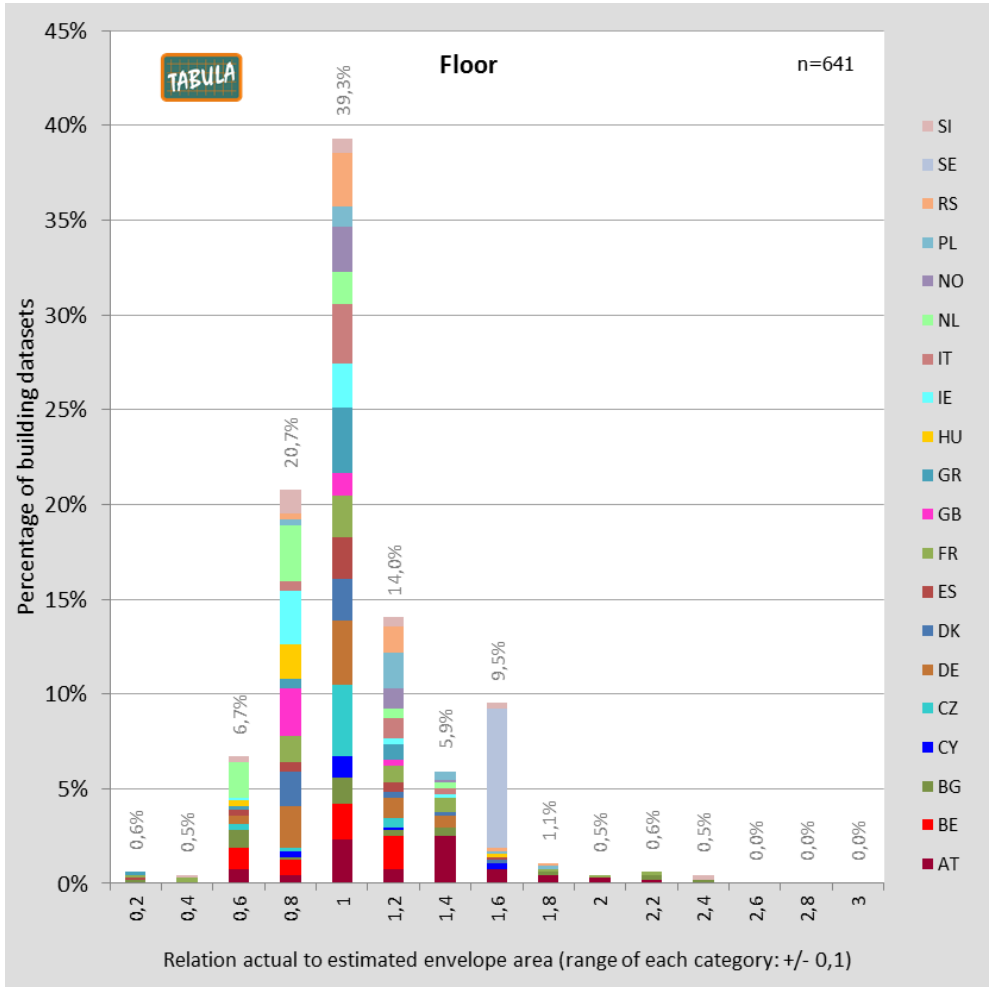

Floor
datasets
(n=186)
estimation
(5 m² + 1,2 * A_C_Ref_Storey)
Floor area [m²]
Reference area per effective storey [m²]
10
100
1000
10000
TABULA

Figure 5 (4 charts): Frequencies of deviations between exact and estimated envelope area per envelope type and per country



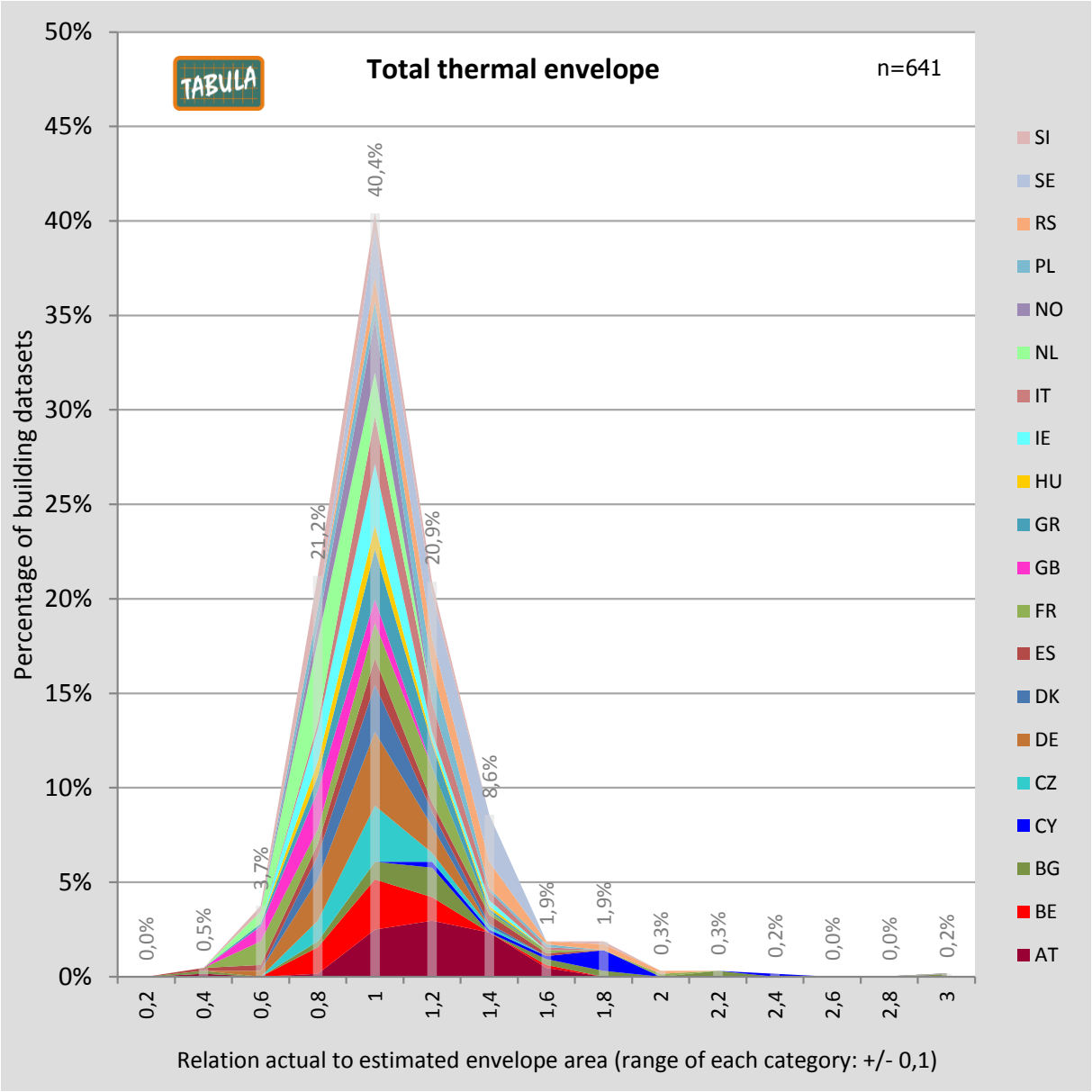



TABULA
Façade (walls + windows)
n=641
Percentage of building datasets
35%
30%
25%
20%
15%
10%
5%
0%
0,2%
1,2%
8,1%
20,9%
30,1%
19,5%
10,5%
3,4%
1,7%
1,2%
0,9%
0,8%
0,6%
0,2%
0,2%
0,2
0,4
0,6
0,8
1
1,2
1,4
1,6
1,8
2
2,2
2,4
2,6
2,8
3
Relation actual to estimated envelope area (range of each category: +/- 0,1)
SI
SE
RS
PL
NO
NL
IT
IE
HU
GR
GB
FR
ES
DK
DE
CZ
CY
BG
BE
AT


TABULA
Floor
n=641
Percentage of building datasets
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0,6%
0,5%
6,7%
20,7%
39,3%
14,0%
5,9%
9,5%
1,1%
0,5%
0,6%
0,5%
0,0%
0,0%
0,0%
0,2
0,4
0,6
0,8
1
1,2
1,4
1,6
1,8
2
2,2
2,4
2,6
2,8
3
Relation actual to estimated envelope area (range of each category: +/- 0,1)
SI
SE
RS
PL
NO
NL
IT
IE
HU
GR
GB
FR
ES
DK
DE
CZ
CY
BG
BE
AT

26-05-2015

Figure 6 (1 chart): Frequencies of deviations between exact and estimated total envelope area per country



26-05-2015

3 Thermal Quality of Construction Elements and Insulation Measures

3.1 Example Buildings: Cross-Country Comparison of Average U-Values (without refurbishments) by Decades

T
he example-building database offers the opportunity to compare typical U-values for different time bands between countries. To attain this goal the following analysis has been conducted:

- For each example building average U-values without refurbishments (energy performance level 1) have been determined for the four envelope types: roof, window, wall, floor.
- Mean U-values have then been calculated for all relevant decades by averaging over the example buildings representing the four building size classes. In case of a change of construction year class during a decade the average is based on the concerning two construction year classes weighted by the respective share of years.

The following mean U-values have been calculated by use of this procedure (data source: sheet "Tab.Building"):

Table 7: **Average U-values of example buildings by country and decade** (data source: sheet "Tab.Building")

decade	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
	U-values of roofs [W/(m²K]																			
... 1900	1,11	2,21	1,24	3,42	0,96	2,01	0,65	3,06	1,42	2,30	2,83	0,90	1,07	1,60	3,06	0,51	0,83	0,53	0,31	1,51
1901 ... 1910	1,11	2,21	1,24	3,42	0,96	1,17	0,83	3,42	1,42	2,30	2,83	0,90	0,76	1,65	3,06	0,51	0,83	0,53	0,31	1,51
1911 ... 1920	1,06	2,21	1,28	3,42	0,96	1,13	0,83	3,42	1,69	2,30	2,83	0,90	0,76	1,65	3,06	0,51	0,83	0,55	0,31	1,51
1921 ... 1930	0,89	2,21	1,45	3,42	1,03	0,99	0,83	3,42	1,87	2,30	2,83	0,90	0,77	1,53	3,06	0,51	0,83	0,64	0,31	1,51
1931 ... 1940	0,89	2,21	1,27	3,42	1,03	0,99	1,20	3,12	1,87	2,30	2,83	0,90	0,85	1,53	3,06	0,51	0,83	0,64	0,31	1,51
1941 ... 1950	0,80	2,41	1,27	3,42	1,00	1,00	1,20	2,67	1,87	2,30	2,83	0,89	0,90	1,59	3,06	0,51	0,70	0,66	0,31	1,22
1951 ... 1960	0,73	2,60	1,24	3,42	0,97	0,91	0,45	2,63	1,89	2,30	2,83	0,89	1,28	1,65	3,06	0,42	0,57	0,69	0,31	0,93
1961 ... 1970	0,73	2,60	0,93	3,42	0,78	0,55	0,31	2,34	1,94	1,82	2,83	0,89	1,17	1,56	1,92	0,33	0,58	0,92	0,21	0,93
1971 ... 1980	0,73	0,82	0,93	3,42	0,78	0,50	0,31	2,20	1,15	1,50	2,83	0,83	0,82	1,23	0,93	0,26	0,60	0,97	0,18	0,85
1981 ... 1990	0,50	0,82	0,93	3,42	0,35	0,41	0,17	0,93	0,43	0,40	2,24	0,33	0,40	0,90	0,77	0,26	0,59	0,63	0,14	0,44
1991 ... 2000	0,27	0,51	0,80	3,42	0,31	0,35	0,17	0,93	0,31	0,40	2,24	0,31	0,32	0,57	0,43	0,19	0,48	0,62	0,13	0,44
2001 ... 2010	0,18	0,41	0,26	2,36	0,29	0,23	0,16	0,74	0,23	0,29	0,50	0,27	0,22	0,42	0,32	0,11	0,40	0,62	0,12	0,19
2011 ... 2013	0,20	0,24	0,23	0,77	0,20	0,20	0,11	0,46	0,21	0,18	0,45	0,23	0,16	0,28	0,25	0,13	0,33	0,32	#NV	0,21
2014	0,20	0,21	0,23	0,60	0,20	0,20	0,11	0,46	0,14	0,18	0,45	0,23	0,16	0,28	0,25	0,13	0,33	0,17	#NV	0,21
2015	0,20	0,21	0,23	0,60	0,20	0,20	0,11	0,46	0,14	0,18	0,45	0,23	0,16	0,28	0,17	0,13	0,33	0,17	#NV	0,21
2016	0,20	0,21	0,23	0,60	0,20	0,18	0,11	0,46	0,14	0,18	0,45	0,23	0,16	0,28	0,17	0,13	0,33	0,17	#NV	0,21
	U-values of walls [W/(m²K]																			
... 1900	1,15	2,11	1,35	1,39	1,27	1,93	1,25	1,72	1,68	2,10	2,43	0,96	2,17	1,37	3,40	0,93	1,68	1,03	0,61	1,83
1901 ... 1910	1,15	2,11	1,35	1,39	1,27	1,83	1,24	2,63	1,68	2,10	2,43	0,96	2,03	1,38	3,40	0,93	1,68	1,03	0,61	1,83
1911 ... 1920	1,26	2,11	1,32	1,39	1,27	1,79	1,24	2,63	1,90	2,10	2,43	0,96	2,03	1,38	3,40	0,93	1,68	1,03	0,61	1,83
1921 ... 1930	1,67	2,11	1,21	1,39	1,34	1,63	1,24	2,63	2,06	2,10	2,43	0,96	2,04	1,48	3,40	0,93	1,68	1,05	0,61	1,83
1931 ... 1940	1,67	2,11	1,45	1,39	1,34	1,63	1,39	2,61	2,06	2,10	2,43	0,96	2,20	1,48	3,40	0,93	1,68	1,05	0,61	1,83
1941 ... 1950	1,50	1,89	1,45	1,39	1,38	1,55	1,39	2,58	2,15	1,88	2,43	1,26	2,20	1,41	3,40	0,93	1,62	1,20	0,61	1,86
1951 ... 1960	1,39	1,67	1,40	1,39	1,41	1,22	1,09	2,47	2,54	1,73	2,43	1,46	2,16	1,35	3,40	0,78	1,55	1,34	0,61	1,90
1961 ... 1970	1,17	1,67	0,90	1,39	1,25	1,15	0,59	1,47	2,32	1,65	2,43	1,46	2,01	1,18	2,76	0,63	1,40	1,38	0,37	1,90
1971 ... 1980	1,17	1,16	0,90	1,39	1,25	1,00	0,43	1,39	1,17	1,60	2,43	1,45	1,58	0,97	1,39	0,42	1,17	1,18	0,33	1,42
1981 ... 1990	0,72	1,16	0,90	1,39	0,92	0,65	0,37	0,63	0,51	1,60	1,79	1,27	0,72	0,75	0,77	0,32	1,11	1,10	0,26	0,52
1991 ... 2000	0,34	0,60	0,81	1,39	0,57	0,49	0,35	0,63	0,36	1,60	1,79	0,49	0,57	0,58	0,43	0,28	0,40	0,50	0,24	0,52
2001 ... 2010	0,23	0,50	0,42	1,16	0,34	0,30	0,23	0,57	0,32	0,71	0,76	0,36	0,38	0,46	0,34	0,14	0,20	0,50	0,25	0,27
2011 ... 2013	0,34	0,28	0,39	0,82	0,25	0,28	0,17	0,49	0,28	0,28	0,50	0,22	0,21	0,34	0,29	0,19	0,19	0,36	#NV	0,27
2014	0,34	0,23	0,39	0,65	0,25	0,21	0,17	0,49	0,22	0,28	0,50	0,22	0,21	0,34	0,22	0,19	0,19	0,29	#NV	0,27
2015	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2016	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

decade	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
	U-values of windows [W/(m²K]																			
... 1900	2,2	5,0	5,9	6,1	2,7	2,8	2,7	5,2	4,3	4,8	4,5	3,5	4,8	5,1	3,5	2,1	5,0	3,8	2,3	2,4
1901 ... 1910	2,2	5,0	5,9	6,1	2,7	2,8	2,7	5,0	4,3	4,8	4,5	3,5	4,8	5,1	3,5	2,1	5,0	3,8	2,3	2,4
1911 ... 1920	2,2	5,0	5,9	6,1	2,7	2,8	2,7	5,0	4,0	4,8	4,5	3,5	4,8	5,1	3,5	2,1	5,0	3,7	2,3	2,4
1921 ... 1930	2,3	5,0	5,6	6,1	2,7	2,9	2,7	5,0	3,8	4,8	4,5	3,5	4,9	5,1	3,5	2,1	5,0	3,5	2,3	2,4
1931 ... 1940	2,3	5,0	3,5	6,1	2,7	2,9	2,7	4,9	3,8	4,8	4,5	3,5	5,3	5,1	3,5	2,1	5,0	3,5	2,3	2,4
1941 ... 1950	2,3	5,0	3,5	6,1	2,7	2,9	2,7	4,9	3,7	4,8	4,5	3,2	5,3	5,0	3,5	2,1	4,6	3,5	2,3	2,5
1951 ... 1960	2,3	5,0	3,4	6,1	2,8	2,9	2,8	4,9	3,2	4,8	4,5	3,0	5,6	4,9	3,5	2,4	4,2	3,5	2,3	2,7
1961 ... 1970	2,2	5,0	2,5	6,1	2,8	2,9	2,8	5,4	3,2	4,0	4,5	3,0	5,5	4,9	3,4	2,6	3,6	3,5	2,3	2,7
1971 ... 1980	2,2	3,9	2,5	6,1	2,8	2,9	2,7	5,2	3,1	3,5	4,5	3,0	4,8	4,1	3,2	2,7	2,6	3,4	2,1	2,7
1981 ... 1990	2,1	3,9	2,5	6,1	2,8	3,1	2,3	3,2	2,7	3,1	5,5	2,5	3,7	3,3	3,1	2,2	2,6	3,2	2,0	2,0
1991 ... 2000	1,3	3,5	2,3	6,1	2,0	2,3	2,2	3,2	2,6	3,1	5,5	2,0	3,1	2,8	2,2	2,2	1,8	3,0	1,9	2,0
2001 ... 2010	1,4	2,8	1,4	4,9	1,5	1,4	1,6	3,2	1,6	2,2	4,1	1,8	2,5	2,5	1,9	1,0	1,4	3,0	1,9	1,2
2011 ... 2013	1,4	1,8	1,0	3,2	1,2	1,3	1,1	3,2	1,5	1,9	2,9	1,5	1,3	2,2	1,8	1,2	1,3	1,9	#NV	1,1
2014	1,4	1,7	1,0	3,2	1,2	1,3	1,1	3,2	1,4	1,9	2,9	1,5	1,3	2,2	1,8	1,2	1,3	1,3	#NV	1,1
2015	1,4	1,7	1,0	3,2	1,2	1,3	1,1	3,2	1,4	1,9	2,9	1,5	1,3	2,2	1,8	1,2	1,3	1,3	#NV	1,1
2016	1,4	1,7	1,0	3,2	1,2	1,1	1,1	3,2	1,4	1,9	2,9	1,5	1,3	2,2	1,8	1,2	1,3	1,3	#NV	1,1
	U-values of floors [W/(m²K]																			
... 1900	1,21	0,75	0,32	1,83	1,94	1,52	0,89	1,40	2,21	0,50	2,75	0,90	1,78	1,30	3,63	0,58	1,86	0,79	0,30	1,14
1901 ... 1910	1,21	0,75	0,32	1,83	1,94	0,92	1,02	1,24	2,21	0,50	2,75	0,90	1,52	1,60	3,63	0,58	1,86	0,79	0,30	1,14
1911 ... 1920	1,19	0,75	0,34	1,83	1,94	0,89	1,02	1,24	1,70	0,50	2,75	0,90	1,52	1,60	3,63	0,58	1,86	0,79	0,30	1,14
1921 ... 1930	1,10	0,75	0,51	1,83	1,06	0,78	1,02	1,24	1,36	0,50	2,75	0,90	1,50	1,60	3,63	0,58	1,86	0,82	0,30	1,14
1931 ... 1940	1,10	0,75	1,27	1,83	1,06	0,78	1,06	1,23	1,36	0,50	2,75	0,90	1,33	1,60	3,63	0,58	1,86	0,82	0,30	1,14
1941 ... 1950	1,24	0,73	1,27	1,83	1,06	0,87	1,06	1,21	1,45	0,48	2,75	0,86	1,32	1,40	3,63	0,58	1,70	0,83	0,30	1,10
1951 ... 1960	1,34	0,72	1,27	1,83	1,06	1,17	0,60	1,18	1,80	0,47	2,75	0,84	1,23	1,20	3,63	0,79	1,55	0,83	0,30	1,06
1961 ... 1970	0,75	0,72	1,29	1,83	1,00	1,02	0,68	0,89	1,82	0,47	2,75	0,84	1,33	1,54	4,42	1,00	1,43	0,80	0,30	1,06
1971 ... 1980	0,75	0,72	1,29	1,83	1,00	0,76	0,40	0,92	1,21	0,47	2,75	0,82	1,37	1,18	2,76	0,38	1,27	0,88	0,28	0,73
1981 ... 1990	0,56	0,72	1,29	1,83	0,91	0,55	0,23	1,22	0,60	0,50	2,49	0,66	1,20	0,81	1,31	0,34	1,19	0,59	0,25	0,57
1991 ... 2000	0,36	0,61	1,24	1,83	0,65	0,45	0,22	1,22	0,39	0,40	2,49	0,38	0,92	0,64	0,48	0,25	0,83	0,53	0,21	0,57
2001 ... 2010	1,14	0,57	0,95	1,45	0,48	0,31	0,15	1,03	0,27	0,28	0,98	0,34	0,60	0,48	0,33	0,12	0,56	0,53	0,19	0,25
2011 ... 2013	0,37	0,32	0,52	0,86	0,32	0,35	0,12	0,76	0,21	0,21	0,68	0,30	0,33	0,32	0,28	0,15	0,45	0,34	#NV	0,29
2014	0,37	0,21	0,52	0,82	0,32	0,35	0,12	0,76	0,22	0,21	0,68	0,30	0,33	0,32	0,28	0,15	0,45	0,24	#NV	0,29
2015	0,37	0,21	0,52	0,82	0,32	0,35	0,12	0,76	0,22	0,21	0,68	0,30	0,33	0,32	0,28	0,15	0,45	0,24	#NV	0,29
2016	0,37	0,21	0,52	0,82	0,32	0,21	0,12	0,76	0,22	0,21	0,68	0,30	0,33	0,32	0,28	0,15	0,45	0,24	#NV	0,29

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Figure 7: **Comparison of average U-values of roofs and upper ceilings for all example buildings** (data source: sheet "Tab.Building")

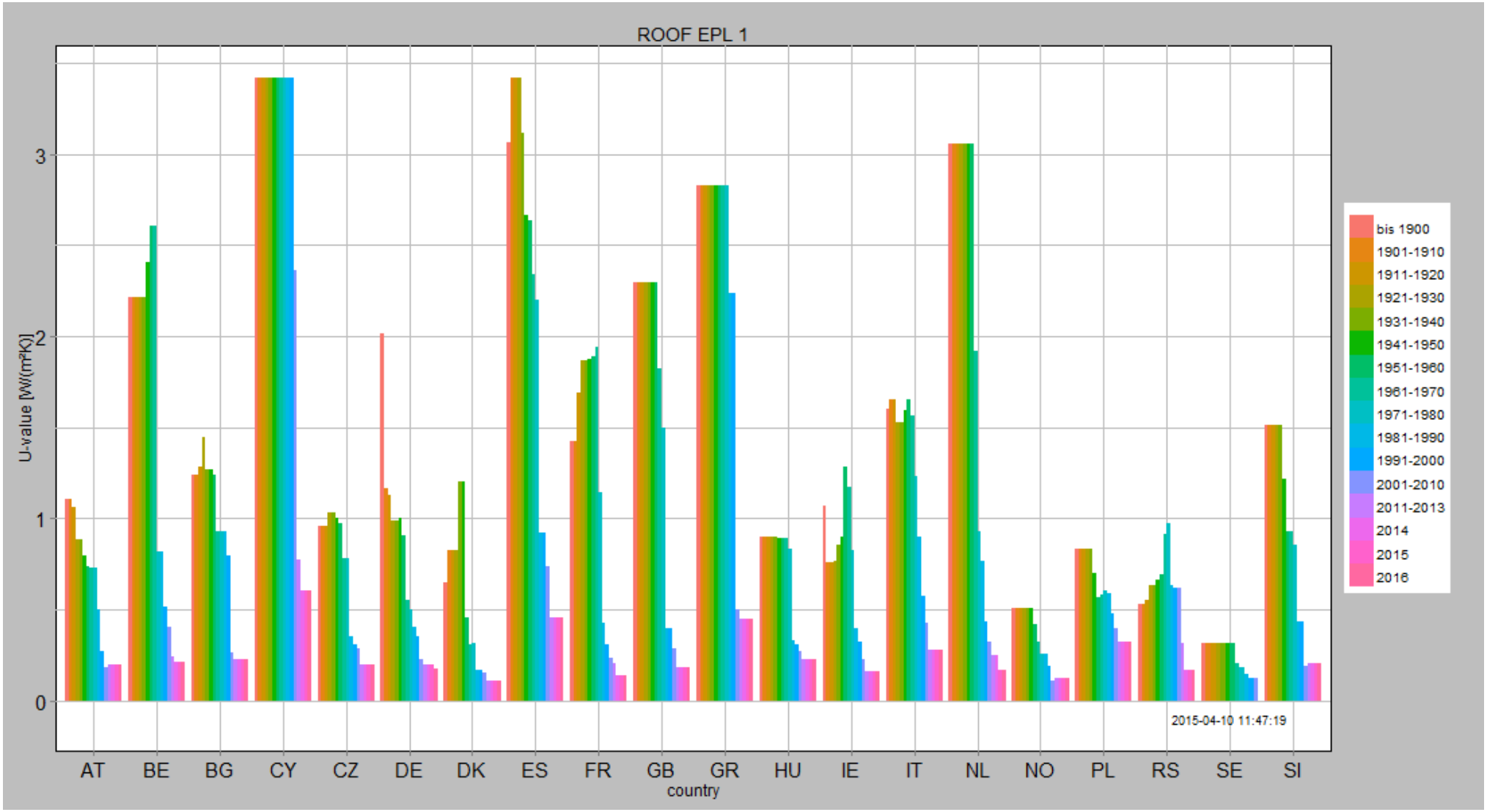

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Figure 8: **Comparison of average U-values of walls for all example buildings** (data source: sheet "Tab.Building")

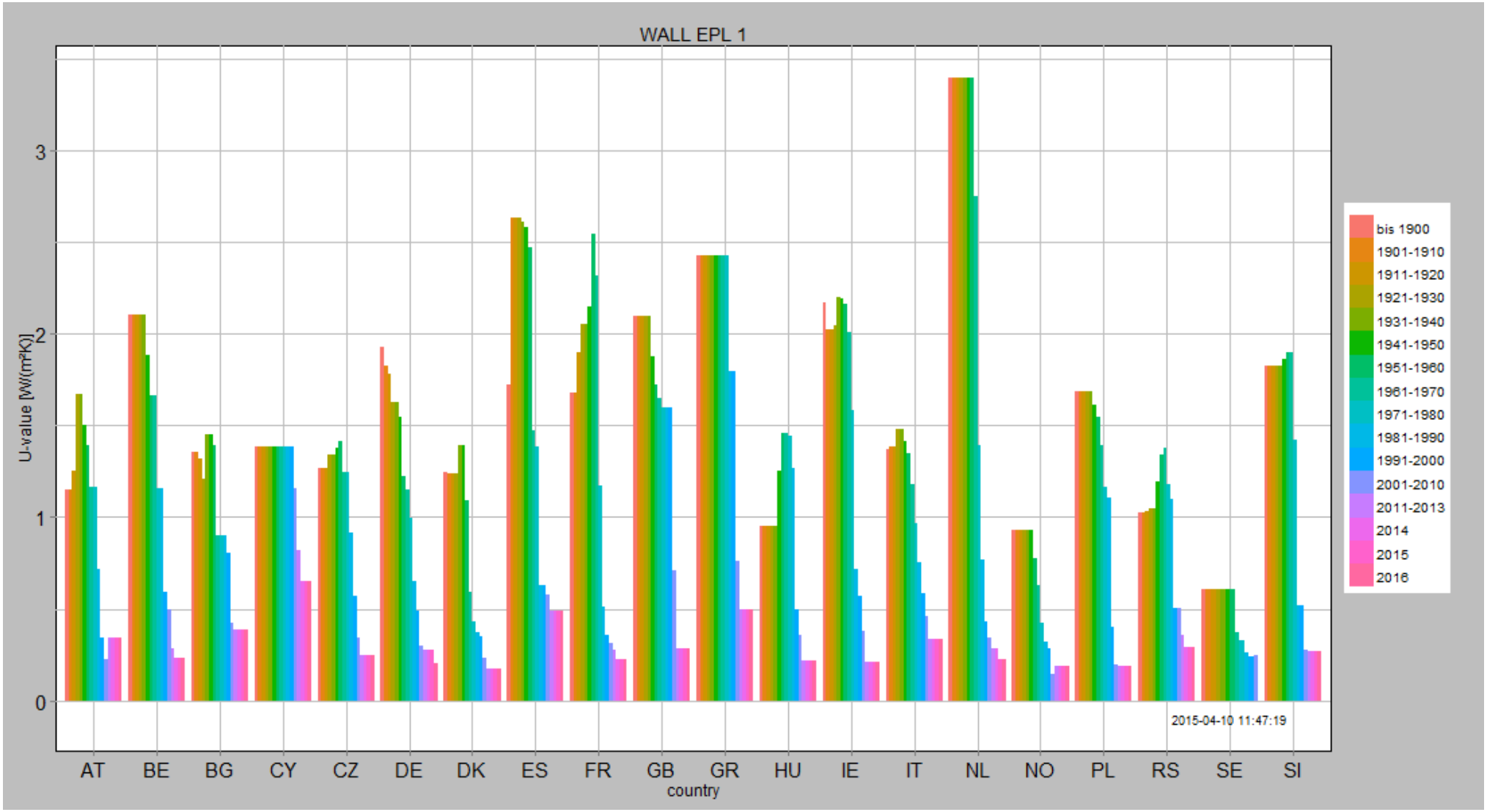

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Figure 9: **Comparison of average U-values of windows for all example buildings** (data source: sheet "Tab.Building")

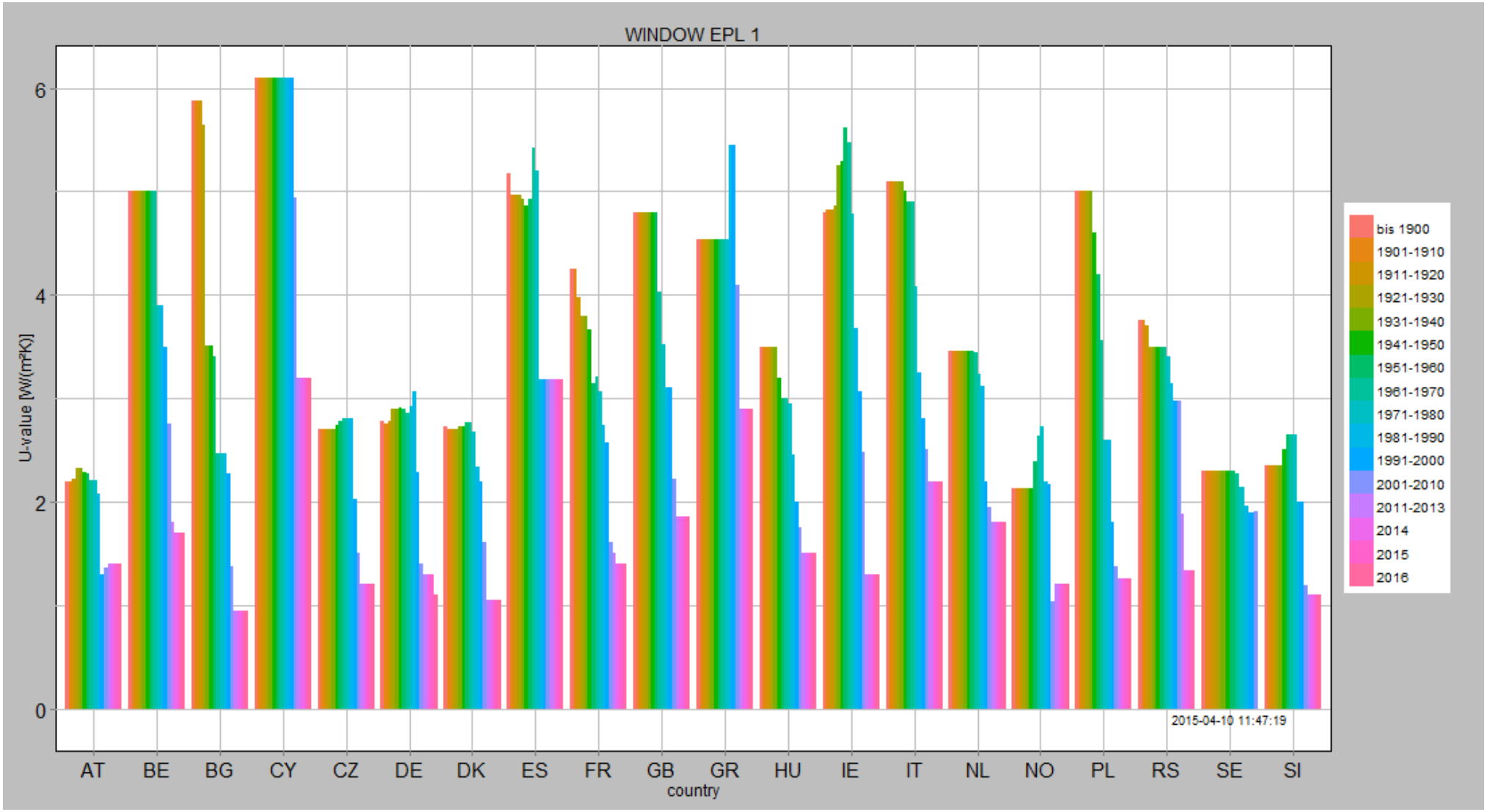

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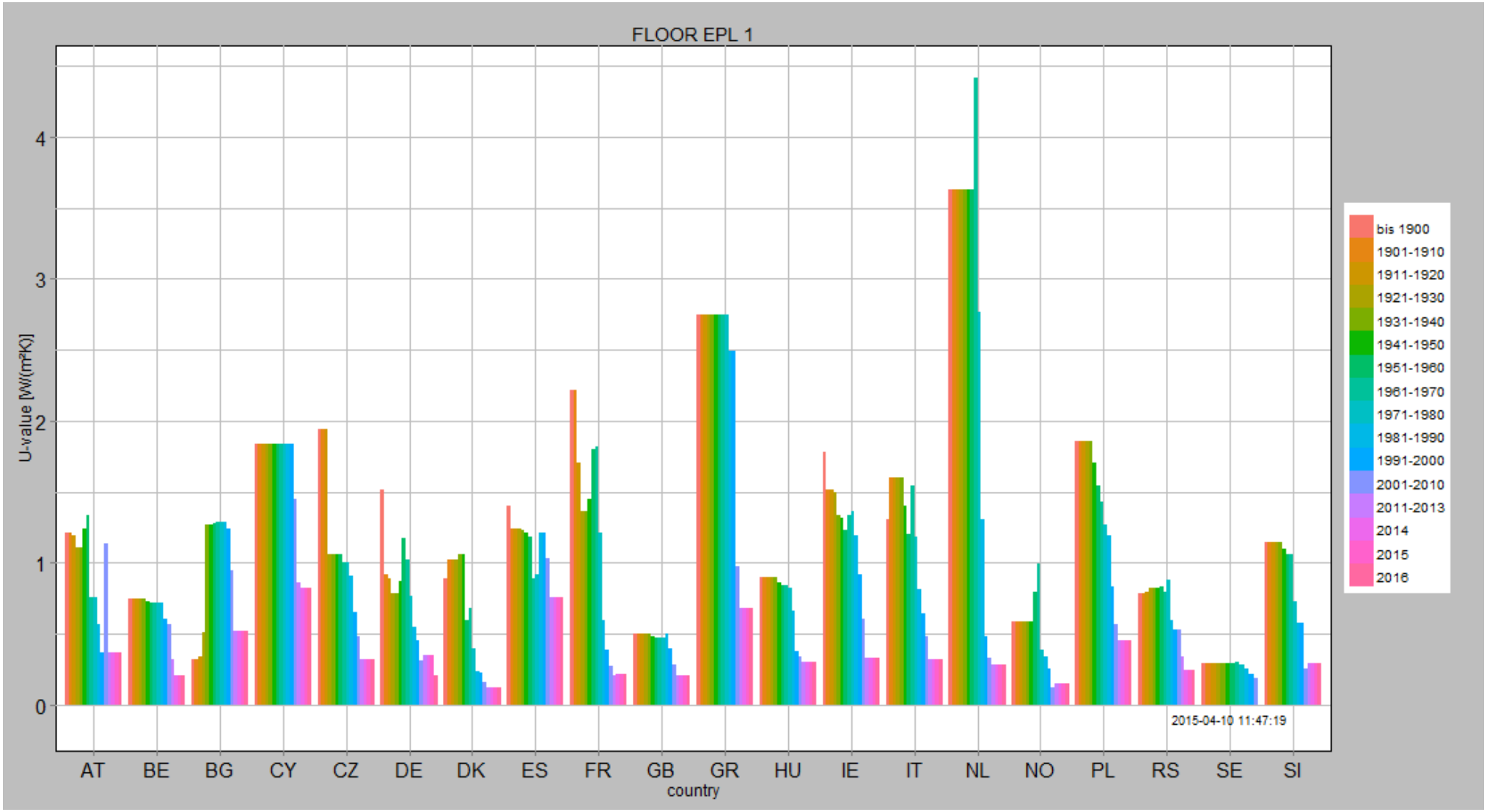
Figure 10: **Comparison of average U-values of floors for all example buildings** (data source: sheet "Tab.Building")



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3.2 Construction Database: Evaluation of U-values by Construction Type and National Period

The construction catalogue (sheet "Tab.Building.Constr") was analysed in the following way:

- For each building average U-values have been determined for the four construction types: roof, upper ceiling, wall, floor. If the information was available a differentiation was made between massive (structures of masonry, concrete, steel, …) and wooden (timber frame, wooden beam ceilings, rafters, …) constructions.
- Mean U-values have then be calculated for each national construction year class by averaging over the example buildings representing the four building size classes of the respective time band.

The following table shows the results:

Table 8: Evaluation of the construction catalogue / opaque elements (data source: sheet "Tab.Building.Constr")

Country Code	Construction Year Class		Roof	Upper Ceiling	Wall	Floor
	Code	from ... to	massive / wooden	massive / wooden	massive / wooden	massive / wooden
			U-Value [W/m²K]			
AT	AT.01	... 1918	1,40	1,50	1,50	1,25
	AT.02	1919 ... 1944	0,95	1,70 / 1,05	1,73	1,55
	AT.03	1945 ... 1960	0,90	1,70 / 0,78	1,27	2,30
	AT.04	1961 ... 1980	0,60	1,67	1,18	0,95
	AT.05	1981 ... 1990	0,49	0,65	0,83	0,70
	AT.06	1991 ... 2000	0,29	0,30	0,31	0,50
	AT.07	2001 ... 2010	0,17 / 0,15	0,20	0,29	0,40
	AT.08	2011 ...	-	-	-	-
BE	BE.01	... 1945	3,50 / 1,70	-	2,13	1,43
	BE.02	1946 ... 1970	3,50 / 1,80	-	1,70	0,85
	BE.03	1971 ... 1990	1,10	-	1,53 / 0,50	0,85
	BE.04	1991 ... 2005	0,59	-	0,68 / 0,50	0,75
	BE.05	2006 ... 2011	0,35	-	0,50 / 0,38	0,47
	BE.06	2012 ...	0,21	-	0,30	0,22
BG	BG.01	... 1918	2,42	1,97	1,40 / 1,10	0,47
	BG.02	1919 ... 1929	2,18	1,97	1,53 / 1,25	0,49 / 0,32
	BG.03	1930 ... 1959	1,33	2,72 / 1,97	1,44 / 1,25	0,52 / 0,32
	BG.04	1960 ... 1998	1,30	2,29 / 1,45	1,47	0,52
	BG.05	1999 ... 2008	0,38	1,28	0,89	0,35
	BG.06	2009 ...	0,38	1,09	0,85	-
CY	CY.01	... 1980	3,86	-	2,23	1,67
	CY.02	1981 ... 2006	0,77	-	1,39	0,77
	CY.03	2007 ... 2013	0,77	-	0,54	0,61
	CY.04	2014 ...	-	-	0,60	0,53
CZ	CZ.01	... 1920	1,90	1,20	1,42	2,02
	CZ.02	1921 ... 1945	1,32	2,20 / 1,25	1,42	1,32
	CZ.03	1946 ... 1960	0,97	1,45 / 1,30	1,40	1,24
	CZ.04	1961 ... 1980	0,72	1,60	1,14	1,26

Country Code	Construction Year Class		Roof	Upper Ceiling	Wall	Floor
	Code	from ... to	massive / wooden	massive / wooden	massive / wooden	massive / wooden
			U-Value [W/m²K]			
	CZ.05	1981 ... 1994	0,35	0,60	0,87	0,99
	CZ.06	1995 ... 2010	0,30 / 0,24	-	0,56	0,52
	CZ.07	2011 ...	0,20	-	0,18	0,35
DE	DE.01	... 1859	1,95	1,00	2,10	2,90 / 1,20
	DE.02	1860 ... 1918	1,95	1,00	2,10	2,90 / 1,20
	DE.03	1919 ... 1948	1,68	0,80	1,55	1,05
	DE.04	1949 ... 1957	1,40	1,85 / 0,80	1,27	1,77
	DE.05	1958 ... 1968	0,90	1,85 / 0,80	1,27	1,57
	DE.06	1969 ... 1978	0,60	0,60	1,05 / 0,60	1,00
	DE.07	1979 ... 1983	0,50	0,50	0,77 / 0,50	0,80
	DE.08	1984 ... 1994	0,40	0,40 / 0,30	0,63 / 0,40	0,60
	DE.09	1995 ... 2001	0,35	0,35 / 0,27	0,53 / 0,30	0,45
	DE.10	2002 ... 2009	0,23	0,30 / 0,24	0,34 / 0,20	0,33
	DE.11	2010 ... 2015	0,24	0,25 / 0,20	0,36 / 0,20	0,33
	DE.12	2016 ...	1,00 / 0,24	0,25 / 0,20	0,49 / 0,20	0,55
DK	DK.01	... 1850	-	0,72	0,83	0,62
	DK.02	1851 ... 1930	-	0,08	0,70 / 0,12	0,09
	DK.03	1931 ... 1950	-	0,08	0,12	0,09
	DK.04	1951 ... 1960	-	0,08	0,12	0,09
	DK.05	1961 ... 1972	-	0,08	0,12	0,09
	DK.06	1973 ... 1978	-	0,08	0,12	0,09
	DK.07	1979 ... 1998	-	0,08	0,12	0,09
	DK.08	1999 ... 2006	-	0,08	0,12	0,09
	DK.09	2007 ... 2010	-	0,08	0,12	0,09
	DK.10	2011 ...	-	0,08	0,14 / 0,12	0,09
ES	ES.01	... 1900	4,87	-	0,24	1,62
	ES.02	1901 ... 1936	2,14	-	2,60	1,83
	ES.03	1937 ... 1959	1,37	-	2,64	1,26
	ES.04	1960 ... 1979	1,91	-	1,68	1,72
	ES.05	1980 ... 2006	0,56	-	0,66	1,94
	ES.06	2007 ...	0,47	-	0,50	1,16
FR	FR.01	... 1914	1,68	1,11	1,85	2,35
	FR.02	1915 ... 1948	1,13	2,49 / 0,84	1,94	2,23
	FR.03	1949 ... 1967	1,88	2,50	1,48	2,40
	FR.04	1968 ... 1974	1,88	0,57 / 0,49	1,41	0,88
	FR.05	1975 ... 1981	0,62	0,57 / 0,49	0,57	0,88
	FR.06	1982 ... 1989	0,62	0,32	0,48	0,67
	FR.07	1990 ... 2000	0,53 / 0,43	0,25	0,46	0,43
	FR.08	2001 ... 2005	0,32	0,24	0,32	0,36
	FR.09	2006 ... 2012	0,21	0,15	0,31	0,26
	FR.10	2013 ...	0,19	0,15	0,21 / 0,18	0,17
GB	GB.01	... 1918	2,30	-	2,10	0,59
	GB.02	1919 ... 1944	2,30	-	2,10	-
	GB.03	1945 ... 1964	2,30	-	2,10	-

Country Code	Construction Year Class		Roof	Upper Ceiling	Wall	Floor
	Code	from ... to	massive / wooden	massive / wooden	massive / wooden	massive / wooden
			U-Value [W/m²K]			
	GB.04	1965 ... 1980	1,50	-	1,60	-
	GB.05	1981 ... 1990	0,40	-	1,60	-
	GB.06	1991 ... 2003	-	-	1,60	0,45
	GB.07	2004 ... 2009	0,22	-	0,74	0,24
	GB.08	2010 ...	0,18	-	0,74	0,24
GR	GR.01	... 1980	2,27	-	2,72	1,91
	GR.02	1981 ... 2000	1,82 / 0,68	-	0,86	1,21
	GR.03	2001 ... 2010	1,67 / 0,68	-	0,98	1,36
	GR.04	2011 ...	0,60	-	0,69	0,88
HU	HU.01	... 1944	-	1,33	1,02	1,01
	HU.02	1945 ... 1979	0,91	1,22	1,11	0,89
	HU.03	1980 ... 1989	0,44 / 0,36	1,10	1,20	0,84
	HU.04	1990 ... 2005	0,25	0,74	1,14	0,65
	HU.05	2006 ...	0,25	0,23	0,31	0,34
IE	IE.01	... 1899	1,76	-	2,04	1,41
	IE.02	1900 ... 1929	1,76	-	2,02	1,41
	IE.03	1930 ... 1949	1,76	-	2,02	1,41
	IE.04	1950 ... 1966	1,76	-	2,12	1,41
	IE.05	1967 ... 1977	1,76	-	2,09	1,41
	IE.06	1978 ... 1982	0,40	-	1,10	1,17
	IE.07	1983 ... 1993	0,40	-	0,60	1,17
	IE.08	1994 ... 2004	0,32	-	0,55	0,83
	IE.09	2005 ... 2010	0,19	-	0,27	0,50
	IE.10	2011 ...	0,17	-	0,21	0,36
IT	IT.01	... 1900	1,80	2,37	1,61	1,93
	IT.02	1901 ... 1920	1,80	2,41	1,61	1,82
	IT.03	1921 ... 1945	2,03 / 1,80	2,00	1,31	1,65
	IT.04	1946 ... 1960	2,03	1,65	1,82	1,65
	IT.05	1961 ... 1975	2,03	1,65	1,82	1,65
	IT.06	1976 ... 1990	1,08 / 0,95	0,97	0,79	1,11
	IT.07	1991 ... 2005	0,72 / 0,64	0,69	0,60	0,85
	IT.08	2006 ...	0,30	0,30	0,34	0,33
NL	NL.01	... 1964	2,41	-	2,66	3,14
	NL.02	1965 ... 1974	1,16	-	2,33	5,88
	NL.03	1975 ... 1991	0,68	-	0,68	1,15
	NL.04	1992 ... 2005	0,40	-	0,40	0,40
	NL.05	2006 ... 2014	0,25	-	0,29	0,29
	NL.06	2015 ...	0,17	-	0,22	0,29
NO	NO.01	... 1955	0,31	0,65 / 0,45	0,91 / 0,47	1,03 / 0,59
	NO.02	1956 ... 1970	0,31	2,38 / 0,45	0,44	0,34
	NO.03	1971 ... 1980	0,31	2,38 / 0,45	0,44	0,30
	NO.04	1981 ... 1990	0,31	2,38 / 0,45	0,44	0,30
	NO.05	1991 ... 2000	0,21	0,21	0,21	0,27 / 0,20
	NO.06	2001 ... 2010	0,21	0,21	0,19	0,23 / 0,20

Country Code	Construction Year Class		Roof	Upper Ceiling	Wall	Floor
	Code	from ... to	massive / wooden	massive / wooden	massive / wooden	massive / wooden
			U-Value [W/m²K]			
	NO.07	2011 ...	0,21	0,21	0,19	0,23 / 0,20
PL	PL.01	... 1945	0,90 / 0,77	-	1,75 / 0,40	2,00
	PL.02	1946 ... 1966	0,53	-	1,29 / 0,40	1,65
	PL.03	1967 ... 1985	0,53	-	1,29 / 0,40	1,45
	PL.04	1986 ... 1992	0,43	-	0,98 / 0,40	1,25
	PL.05	1993 ... 2002	0,43	-	0,29	0,90
	PL.06	2003 ... 2008	0,33	-	0,29	0,70
	PL.07	2009 ...	0,27	-	0,29	0,55
RS	RS.01	... 1918	0,43	0,69	1,11 / 0,96	1,05 / 0,66
	RS.02	1919 ... 1945	-	1,16	1,15	1,04
	RS.03	1946 ... 1960	-	1,09	3,10	1,06
	RS.04	1961 ... 1970	1,07	1,41	1,59	1,30
	RS.05	1971 ... 1980	0,69	1,73	0,91	0,99
	RS.06	1981 ... 1990	0,38	0,93	1,78	0,57
	RS.07	1991 ... 2011	0,44	1,10	0,52	0,66
	RS.08	2012 ...	0,15	0,28	0,32	0,24
SE	SE.01	... 1960	-	0,33	0,83 / 0,53	0,32
	SE.02	1961 ... 1975	-	0,21	0,36	0,30
	SE.03	1976 ... 1985	-	0,16	0,27	0,28
	SE.04	1986 ... 1995	-	0,14	0,20	0,25
	SE.05	1996 ... 2005	-	0,13	0,20	0,20
SI	SI.01	... 1945	2,70	1,40 / 1,00	1,50 / 0,70	2,05
	SI.02	1946 ... 1970	1,80	1,23 / 1,00	1,60	1,40
	SI.03	1971 ... 1980	0,90	1,00	1,10 / 0,26	0,96
	SI.04	1981 ... 2001	0,43	0,46	0,48 / 0,21	0,65
	SI.05	2002 ... 2008	0,32 / 0,17	0,20	0,25	0,21
	SI.06	2009 ...	0,32 / 0,17	0,20	0,25	0,21

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The analysis of the windows was based on the same procedure. In this case the differentiation concerns the numbers of panes, the type of glazing (standard / low-e) and the frame type (see Table 9). The column "Common" is reflecting the average of the available values.

Table 9: Evaluation of the construction catalogue / windows (data source: sheet "Tab.Building.Constr")

Number of panes	Special glazing	Frame type	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	Common
			U-Value window [W/m²K]																				
1	-	not specified	-	-	-	-	-	-	-	-	-	-	4,7	-	-	-	-	-	-	-	-	-	4,7
	-	wood	4,6	5,0	5,9	4,7	-	3,9	4,4	5,2	4,8	4,8	-	(2,5)	-	4,9	-	4,8	4,5	4,6	-	5,2	4,8
	-	plastic	-	-	-	-	-	-	-	3,1	4,9	-	-	-	4,8	-	-	-	-	-	-	-	4,3
	-	metal	-	5,7	-	6,1	-	-	-	4,1	5,9	-	6,1	-	5,7	5,7	-	-	-	-	-	-	5,6
	Low e	wood	-	-	-	-	-	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	1,8
	Low e	plastic	-	-	-	-	-	-	-	-	-	-	-	1,3	-	-	-	-	-	-	-	-	1,3
	Low e	wood/alu/ins	-	-	-	-	-	-	-	-	-	-	-	1,0	-	-	-	-	-	-	-	-	1,0
2	-	not specified	2,5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,6	-	-	-	2,6
	-	wood	2,3	(3,5)	2,5	2,3	2,3	2,7	2,8	-	2,8	-	2,7	(3,5)	-	2,8	-	2,5	(1,8)	3,3	-	2,4	2,6
	-	plastic	(1,4)	(3,5)	2,6	-	1,8	3,0	-	-	2,9	-	3,1	-	3,0	-	-	-	(1,4)	2,8	-	2,6	2,7
	-	metal	-	4,3	2,9	3,5	-	4,3	-	-	4,1	-	3,9	-	3,7	3,7	-	-	-	-	-	-	3,8
	-	wood thermal break	-	-	-	-	2,8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,8
	-	pvc	-	-	-	-	-	-	-	-	-	2,5	-	-	-	-	-	-	-	-	-	-	2,5
	-	metal thermal break	-	3,5	2,6	-	-	3,2	-	-	-	-	3,3	-	3,4	3,4	-	-	-	3,1	-	-	3,2
	Low e	wood	-	1,6	-	-	1,2	1,4	1,7	-	-	-	(2,3)	-	-	2,2	-	1,8	-	-	-	1,5	1,6
	Low e	plastic	1,2	1,7	1,3	-	-	1,7	-	-	1,6	-	(2,9)	-	1,8	-	-	-	-	-	-	1,2	1,5
	Low e	metal	-	-	-	-	-	-	-	-	-	-	(4,0)	-	-	-	-	-	-	-	-	(1,5)	-
	Low e	synthetic thermal break	-	-	-	-	-	-	-	-	-	-	2,9	-	-	-	-	-	-	-	-	-	2,9
	Low e	metal thermal break	-	2,0	(1,4)	-	-	1,7	-	-	-	-	(2,9)	-	-	2,4	-	-	-	-	-	-	2,0
	Low e	wood/metal	-	-	-	-	-	-	1,3	-	-	-	-	-	-	-	-	-	-	-	-	-	1,3
3	-	wood	1,4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,9	-	-	-	1,7
	-	plastic	0,7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7
	Low e	wood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,5	-	-	-	-	1,5
	Low e	wood	-	1,1	-	-	-	1,0	1,0	-	-	-	-	-	-	-	-	0,9	-	-	-	0,7	0,9
	Low e	plastic	0,8	1,1	1,0	-	-	1,0	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	0,9
	Low e	metal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,9	0,9
	Low e	wood/metal	-	-	-	-	-	-	0,8	-	-	-	-	-	-	-	-	-	-	-	-	-	0,8
	Low e	insulated (passive house window)	0,8	0,9	0,8	-	-	0,8	-	-	0,9	-	-	-	-	-	-	1,0	-	-	-	-	0,9

Remarks 10-04-2015

Values which deviate more than +/- 30% from the average are listed in brackets and are not considered in the column "Common".

The values are mostly very close, however in some cases larger deviations can be observed. The deviations can in principle be explained by different window sizes, glazing distances, gas fillings and glass spacer types. Nevertheless, also errors might have occurred when entering the information into the data sheet.

This should be clarified by the partners during future data revisions.

The averages of the column "Common" can also serve as default values in case no values are available in the database. However, it is strongly recommended to supply and use the respective national values, if any possible. During the revision process of the next years further datasets and classifications should be provided by the partners. Also information should be supplemented from which time on (a) metal windows were typically fabricated with thermal breaks and (b) low-e glazing was dominant.

Table 10: U-values of different window types / derived default values (simplified common values)

Number of panes	Glazing type	Frame type	Default U-value [W/(m²K)]
1	conventional	not specified	4,7
		wood	4,8
		plastic	4,3
		metal	5,6
	low-e	wood	1,8
		plastic	1,3
		wood/alu/ins	1,0
2	conventional	not specified	2,6
		wood	2,6
		plastic	2,7
		metal	3,8
		pvc	2,5
		metal thermal break	3,2
	low-e	wood	1,6
		plastic	1,5
		metal	-
		metal thermal break	2,0
		wood/metal	1,3
3	conventional	wood	1,7
	low-e	plastic	0,7
		wood	1,5
		wood	0,9
		plastic	0,9
		metal	0,9
		wood/metal	0,8
		insulated (passive house window)	0,9

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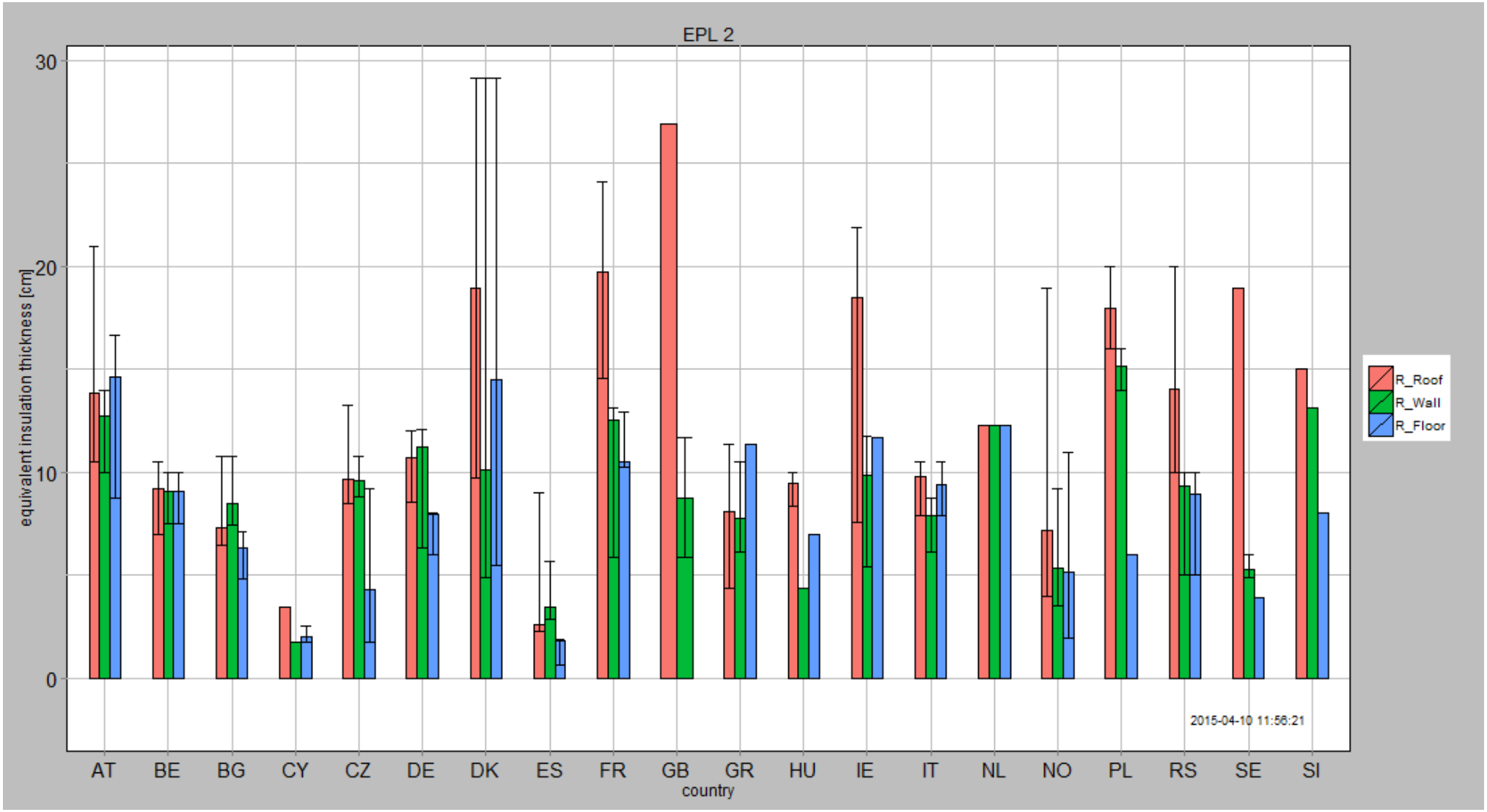
3.3 Measures for Upgrading the Thermal Envelope

The TABULA concept includes the definition of two levels of insulation measures:

- **Refurbishment Package "Standard" = Energy Performance Level (EPL) 2**
  Package of measures for upgrading the thermal envelope and the heat supply system
  which are commonly realised during renovation;
- **Refurbishment Package "Advanced" = Energy Performance Level (EPL) 3**
  Package of measures for upgrading the thermal envelope and the heat supply system,
  that are usually only realised in very ambitious renovations or research projects.

The insulation measure catalogue contains information about the type of measure and the thermal resistances. These values were transformed into equivalent insulation thicknesses in order to get more illustrative values (by applying a standard thermal conductivity of 0,035 W/(m·K)). The result is displayed in the following charts.

Figure 11: **Equivalent insulation thicknesses applied to roofs, walls and floors of the example buildings / Refurbishment Package "Standard" = EPL 2 and "Advanced" = EPL 3** (data source: Calc.Building.Set)



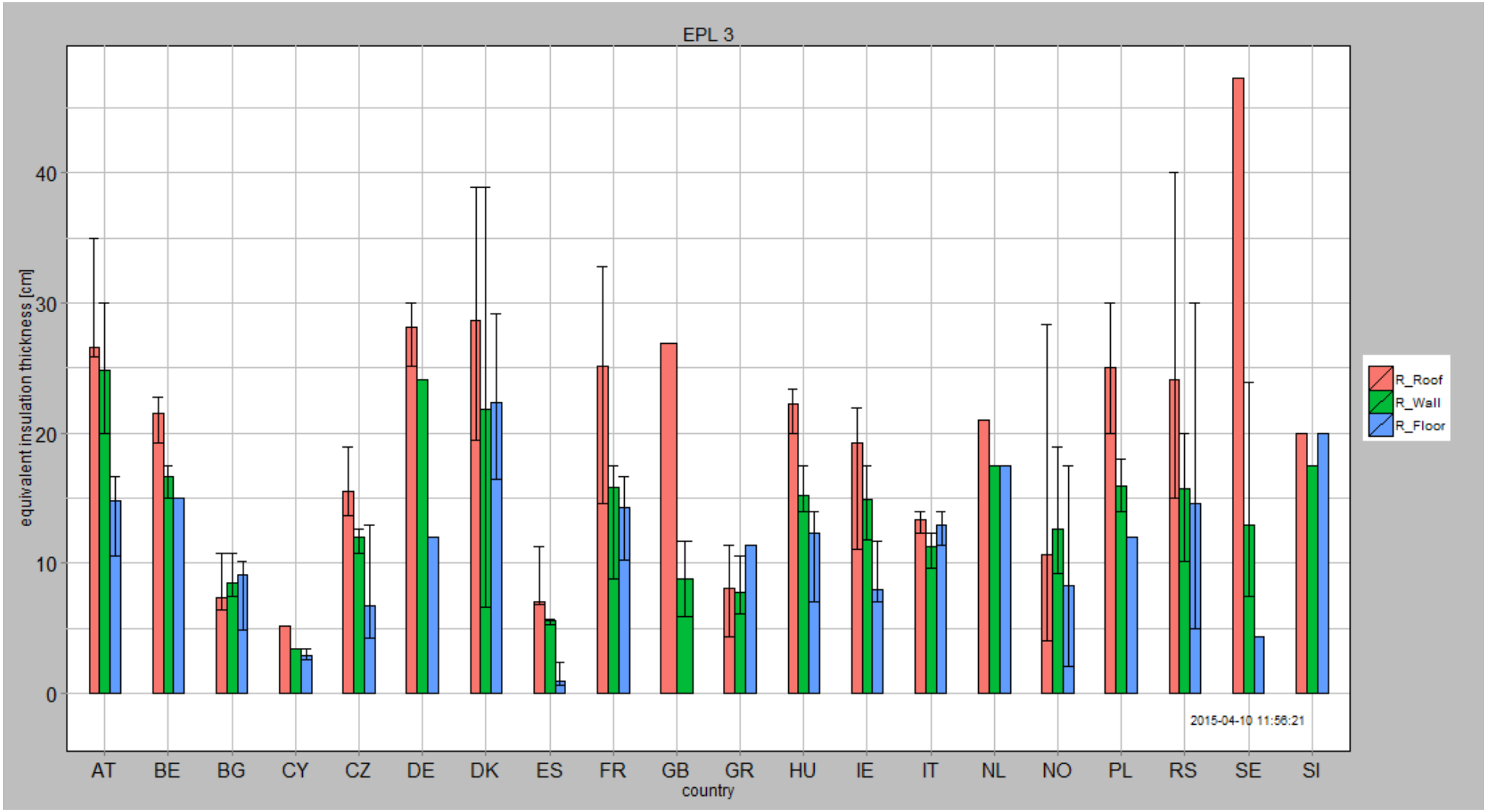
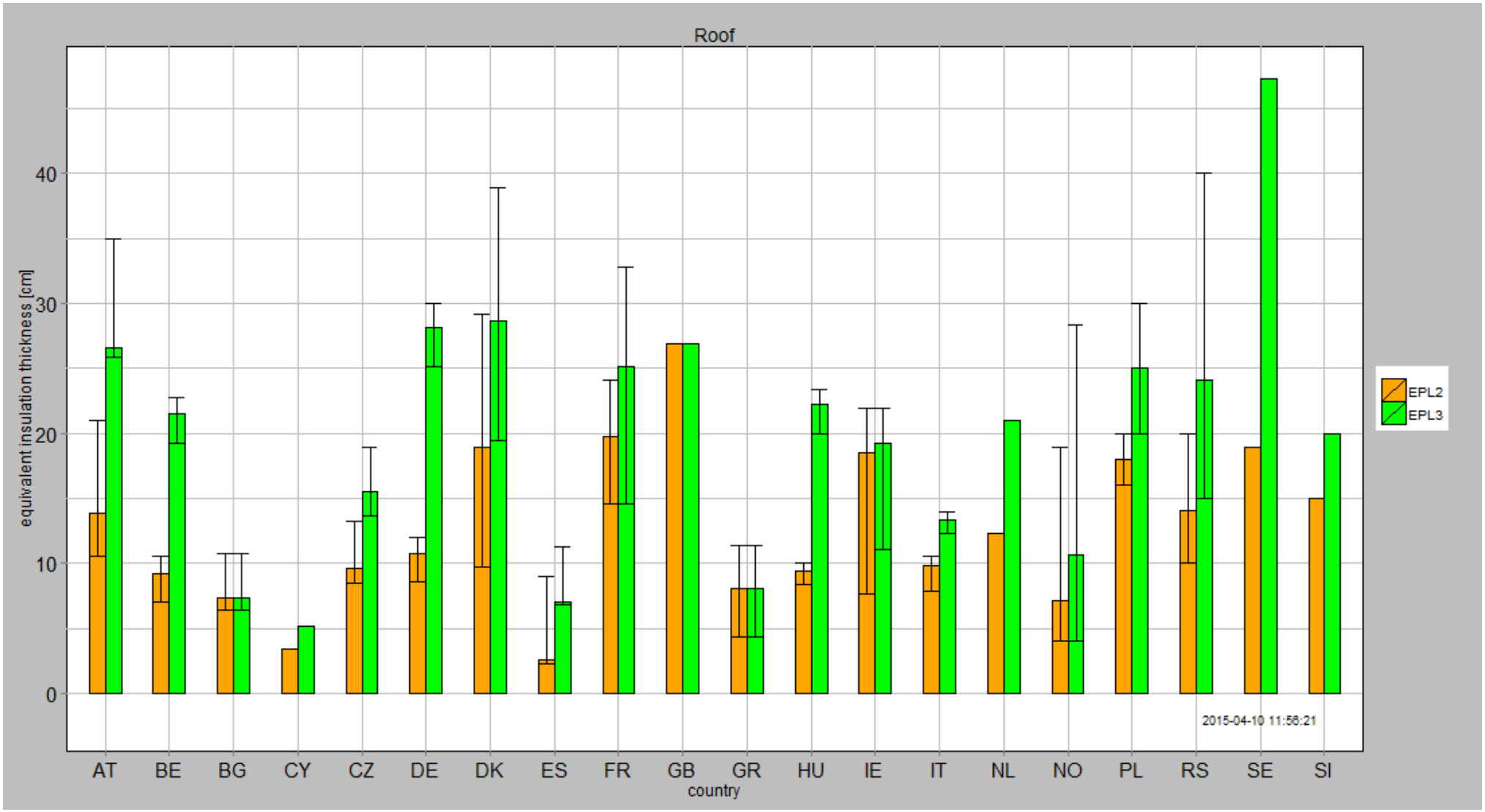
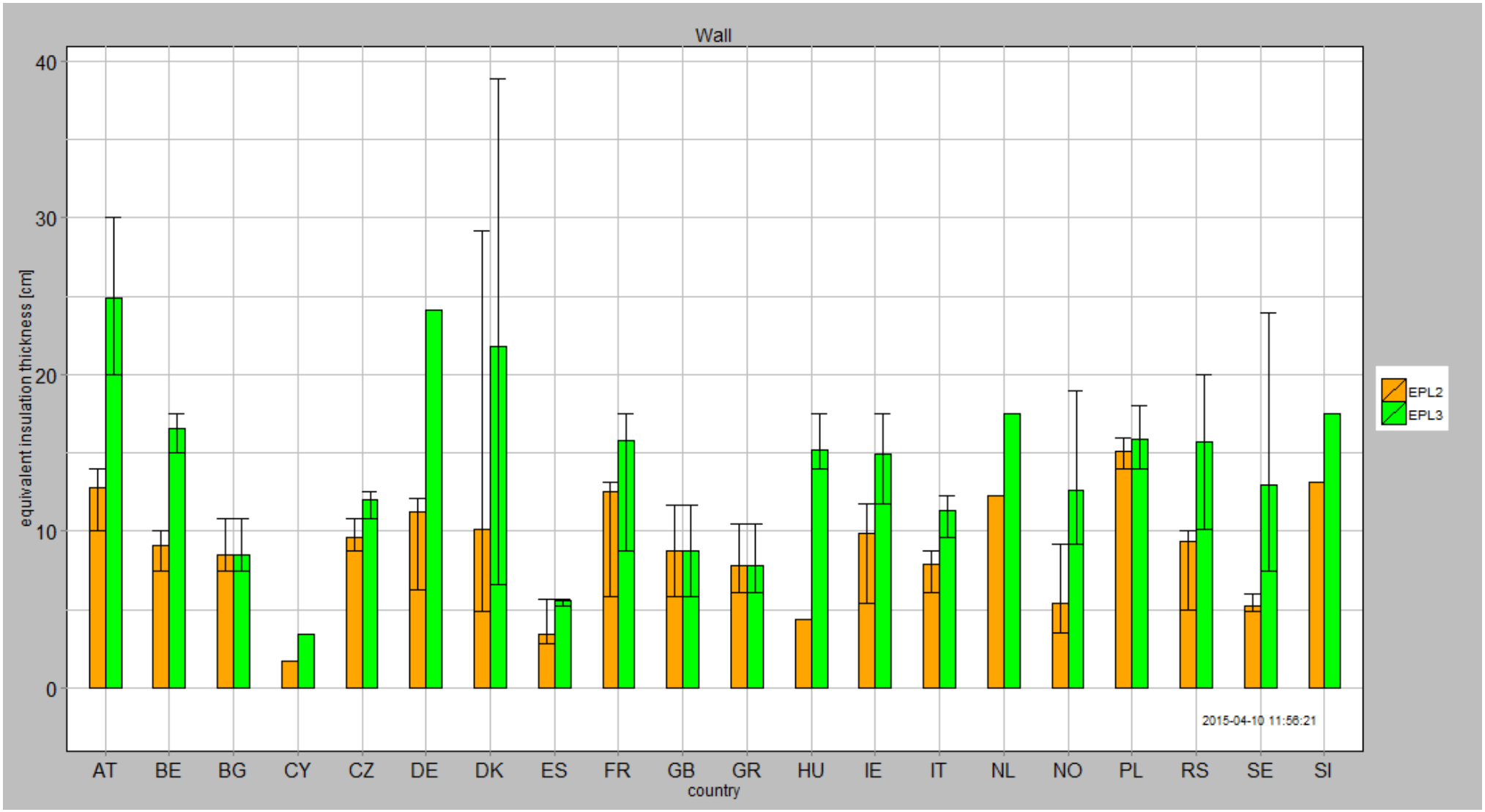
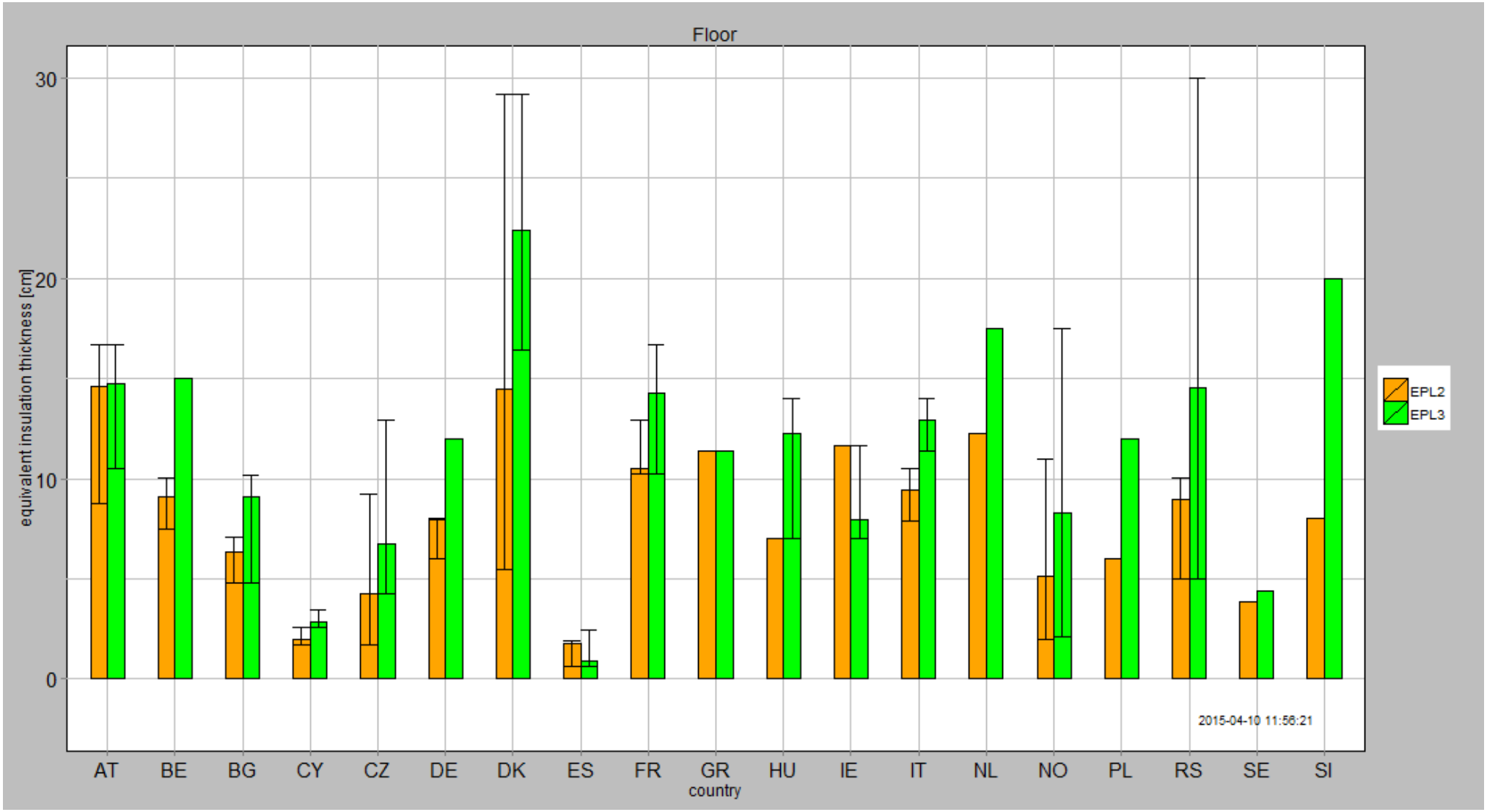
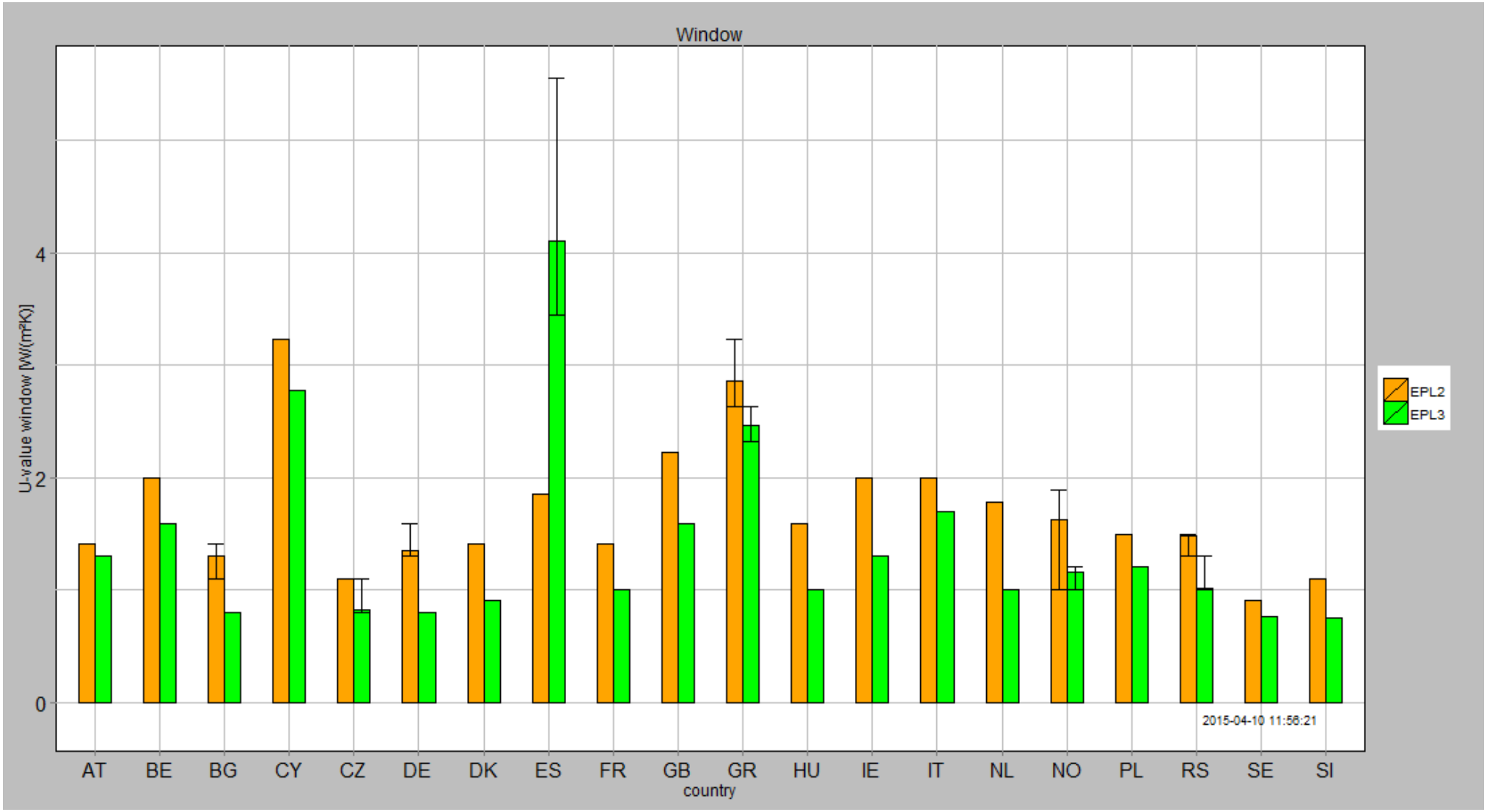

EPL 3
equivalent insulation thickness [cm]
0
10
20
30
40
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SE
SI
country
R_Roof
R_Wall
R_Floor
2015-04-10 11:56:21

Figure 12: **Refurbishment measures applied to example buildings – separate comparison for each envelope type** (data source: Calc.Building.Set)




Wall
equivalent insulation thickness [cm]
40
30
20
10
0
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SE
SI
country
EPL2
EPL3
2015-04-10 11:56:21


Floor
equivalent insulation thickness [cm]
30
20
10
0
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GR
HU
IE
IT
NL
NO
PL
RS
SE
SI
country
EPL2
EPL3
2015-04-10 11:56:21

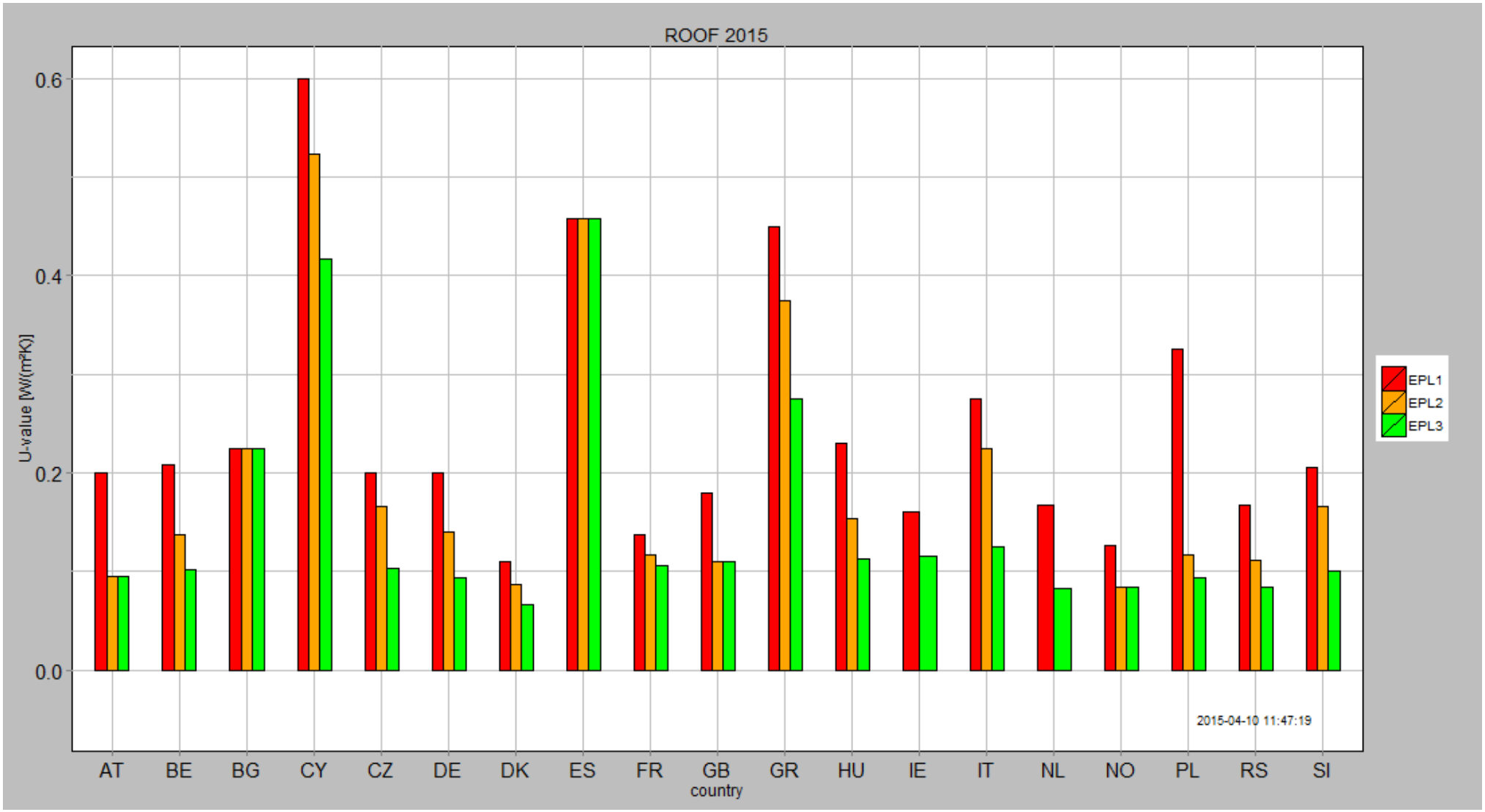

Window
U-value window [W/(m²K)]
4
2
0
EPL2
EPL3
2015-04-10 11:56:21
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SE
SI
country

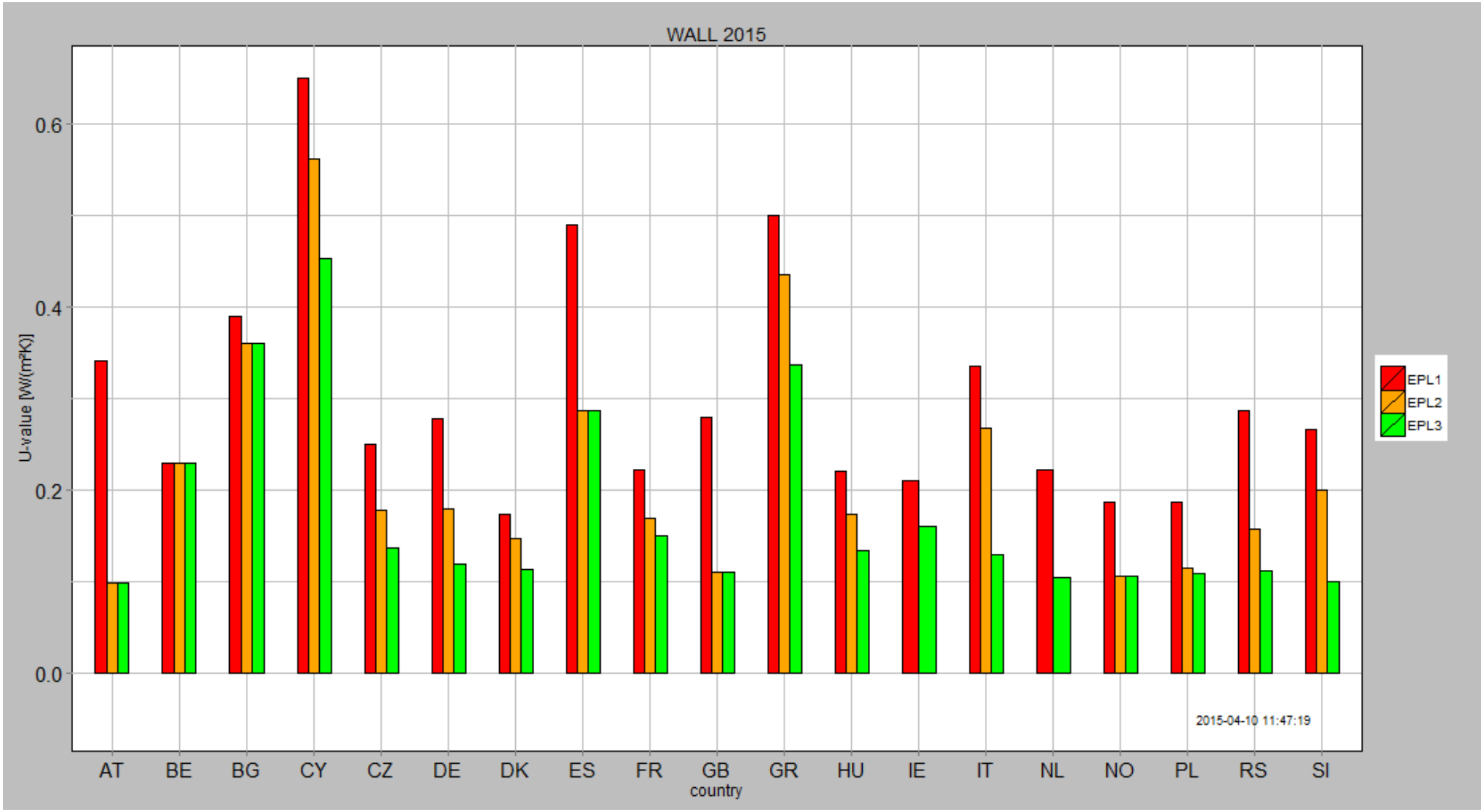
3.4 New Buildings

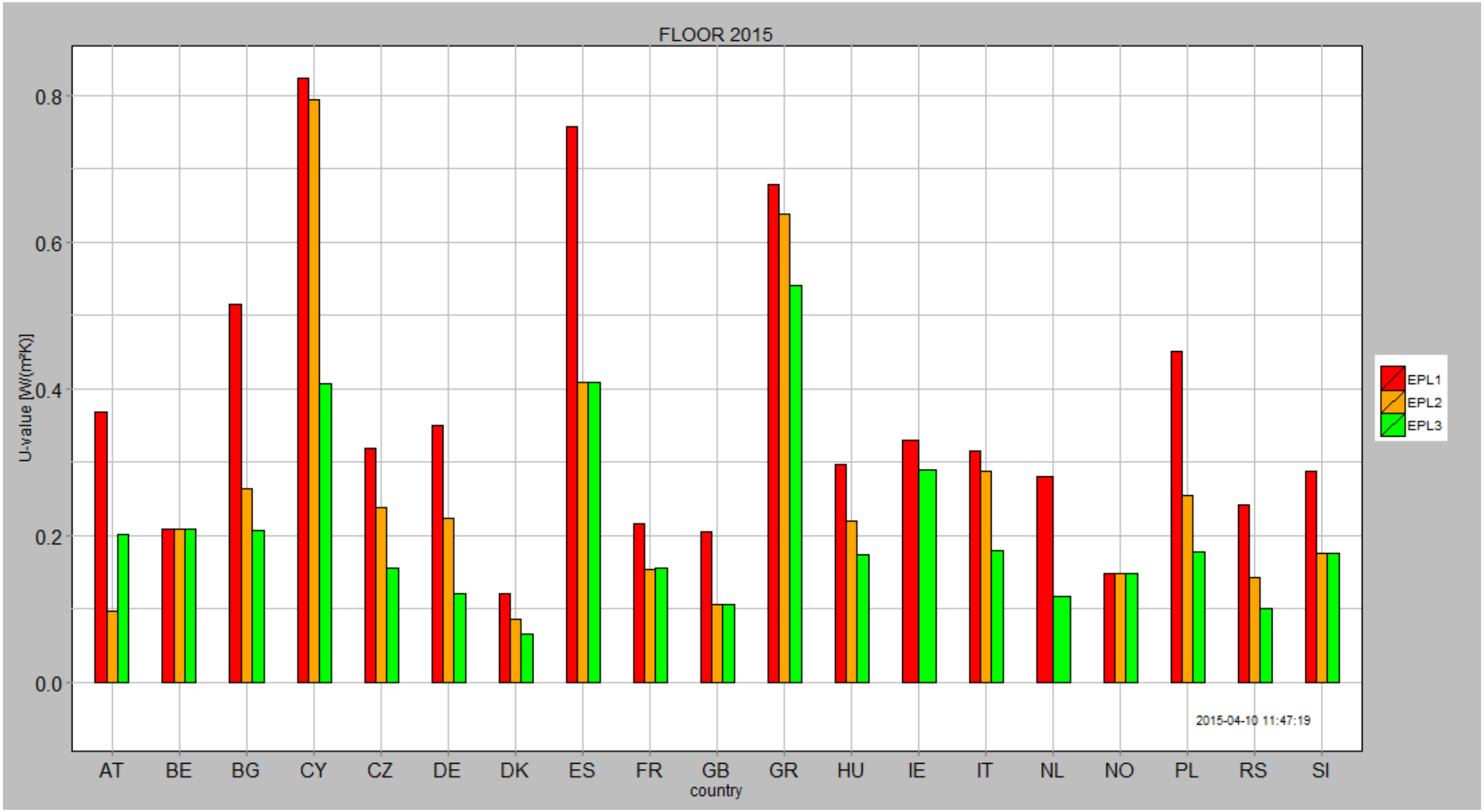
In case of new build a variation of the building and system features is introduced, including the following energy performance levels (EPL):

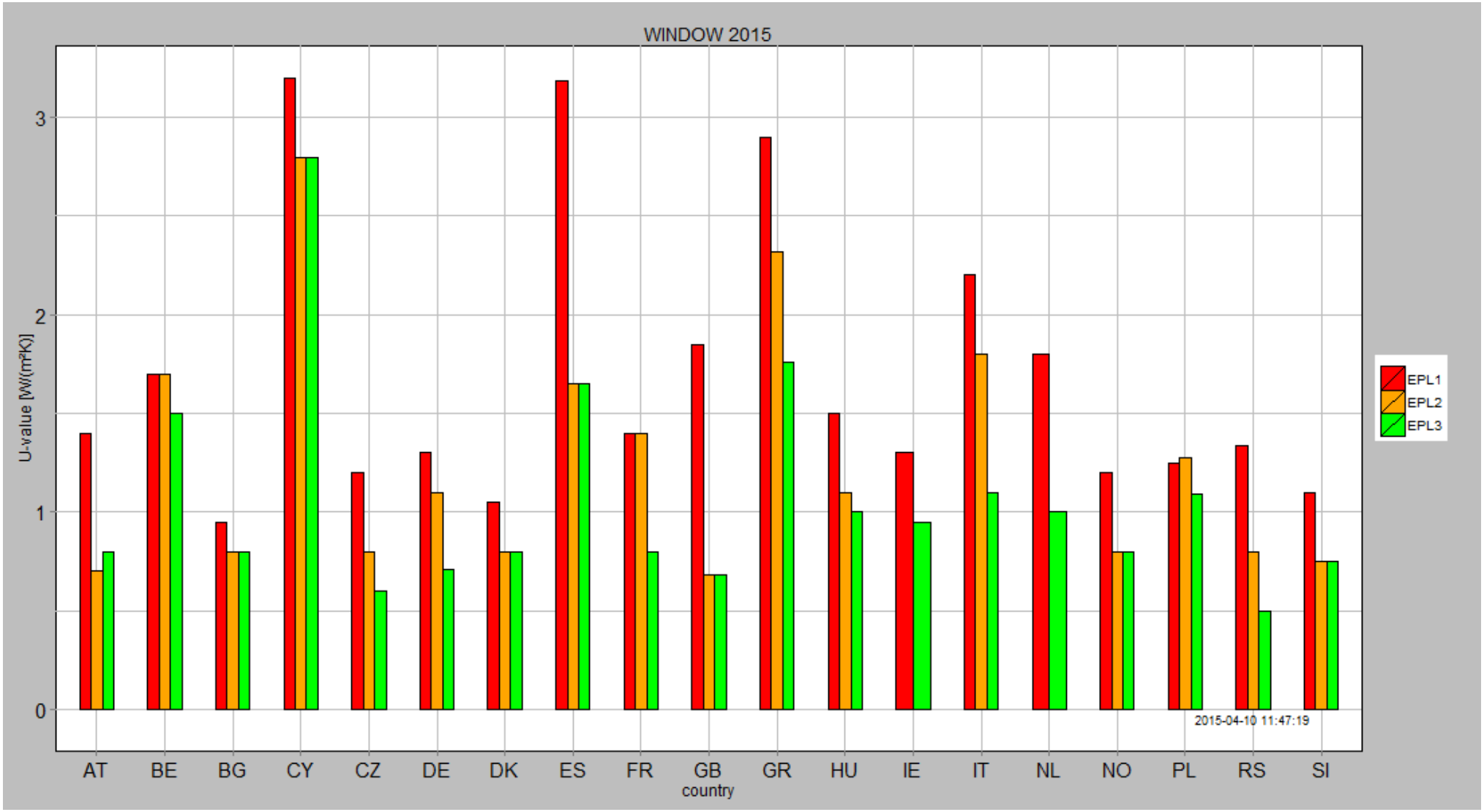
- **EPL1: "Minimum Requirements":** The building complies with the minimum requirements for new build according to the relevant national building code;
- **EPL2: "Improved":** This is an intermediate energy performance level representing e.g. the requirements of grant programmes or improved EPC rating.
- **EPL3: "NZEB":** Future "nearly-zero energy building" level assumed or planned to be introduced in compliance with the "Energy Performance of Buildings" directive of the European Union. For several countries NZEB definitions have not yet been declared officially so far. In these cases, the considerations are based on an energy performance level that is assumed to comply with the NZEB approach. A detailed country-by-country description of the different national approaches for calculating NZEBs and an overview of the showcase buildings can be found in [EPISCOPE SR1 2014]

Figure 13: **U-values of exemplary new buildings – separate comparison for each envelope type** (data source: Calc.Building.Set)




WALL 2015
U-value [W/(m²K)]
0.0
0.2
0.4
0.6
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SI
country
EPL1
EPL2
EPL3
2015-04-10 11:47:19


FLOOR 2015
U-value [W/(m²K)]
0.0
0.2
0.4
0.6
0.8
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SI
country
EPL1
EPL2
EPL3
2015-04-10 11:47:19


WINDOW 2015
U-value [W/(m²K)]
0
1
2
3
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SI
country
EPL1
EPL2
EPL3
2015-04-10 11:47:19

4 Supply System Components

4.1 Description of the Proceeding

The evaluation of supply system characteristics was performed on the basis of 1920 datasets from 20 countries. The values had been determined by each partner on the basis of national methods.[5] The following components were considered:

- HG – Heating Systems / Heat Generation
- HS – Heating Systems / Heat Storage
- HD – Heating Systems / Heat Distribution
- HA – Heating Systems / Auxiliary Energy
- WG – Domestic Hot Water Systems / Heat Generation
- WS – DHW Systems / Heat Storage
- WD – Domestic Hot Water Systems / Heat Distribution
- WA – DHW Systems / Auxiliary Energy
- Vent – Ventilation Systems

For each of these components the data analysis comprised the following steps:

- **Overview of existing data:**
  A data analyses was performed by use of the programme "R". Minimum, maximum and average values were determined, differentiating between single and multi-family houses ("SUH" / "MUH"). The column "Common" reflects the values averaged over all countries and can later be used as default values. For this reason the minimum and maximum numbers in this column should not only be an average of all respective country values but also reflect possibly occurring extreme values of certain countries. Therefore the "Common" minimum and maximum values are determined by creating the mean value of (a) the average of all countries and (b) the most extreme value (of one country).
- **Condensed values:**
  In order to reduce the complexity some of the existing subgroups of component types were merged in so called "condensed values" which also do no more differentiate between single and multi-family houses. The averages and extreme values are now referred to as "poor", "medium" and "high" energy efficiency.
- **Simplified common values / default values:**
  As a last step the values of the column "Common" of each subsystem are transferred into a separate table ("default values / simplified common values"). These tabled values can in the future be useful for rough supranational estimations or in case that national values are not available. Nevertheless, the respective values should be provided for each country finally in order to reflect the specific national technology. After updating of the database the evaluation should be repeated in order to improve the reliability of the derived common values.

[5] see national scientific reports at: http://www.building-typology.eu/tabulapublications.html

4.2 HG – Heating Systems / Heat Generation

Table 11: Energy expenditure factors of heat generation (heating systems) differentiated by country and by building size class (data source: Tab.System.HG)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
B	SUH	min	1,39	-	-	1,13	1,35	-	-	-	-	-	1,22	-	-	-	-	1,18	-	1,42	1,11	-	1,24	-9%
		average	1,41	-	-	1,41	1,57	-	-	-	-	-	1,39	-	-	-	-	1,18	-	1,42	1,11	-	1,35	
		max	1,43	-	-	1,80	1,82	-	-	-	-	-	1,64	-	-	-	-	1,18	-	1,42	1,11	-	1,53	+13%
	MUH	min	1,39	-	-	1,13	1,35	-	-	-	-	-	1,20	-	-	-	-	1,18	-	1,42	1,11	-	1,24	-9%
		average	1,41	-	-	1,41	1,57	-	-	-	-	-	1,37	-	-	-	-	1,18	-	1,42	1,11	-	1,35	-0%
		max	1,43	-	-	1,80	1,82	-	-	-	-	-	1,64	-	-	-	-	1,18	-	1,42	1,11	-	1,53	+13%
	deviation from "common"		+4%			+4%	+16%						+2%					-13%		+5%	-18%		0%	
B_NC	SUH	min	1,30	1,13	1,12	-	-	-	1,07	1,11	-	-	1,53	-	-	1,18	-	1,11	1,16	1,51	1,11	1,35	1,21	-7%
		average	1,31	1,39	1,27	-	-	-	1,12	1,13	-	-	1,53	-	-	1,32	-	1,15	1,16	1,69	1,21	1,35	1,30	
		max	1,33	2,00	1,40	-	-	-	1,16	1,15	-	-	1,53	-	-	1,53	-	1,18	1,16	1,86	1,40	1,35	1,46	+13%
	MUH	min	1,30	1,13	1,12	-	-	-	-	1,11	-	-	1,53	-	-	1,18	-	1,11	1,16	1,51	1,11	1,35	1,23	-7%
		average	1,31	1,39	1,27	-	-	-	-	1,13	-	-	1,53	-	-	1,32	-	1,15	1,16	1,69	1,21	1,35	1,32	+1%
		max	1,33	2,00	1,40	-	-	-	-	1,15	-	-	1,53	-	-	1,57	-	1,18	1,16	1,86	1,40	1,35	1,49	+13%
	deviation from "common"		+0%	+6%	-3%				-15%	-14%			+16%			+1%		-13%	-11%	+29%	-8%	+3%	0%	
B_NC_CT	SUH	min	1,33	1,42	-	1,13	1,28	1,37	1,07	-	1,61	-	0,98	1,24	1,25	-	1,25	-	-	-	-	1,20	1,24	-10%
		average	1,35	1,50	-	1,29	1,37	1,42	1,30	-	1,74	-	1,26	1,27	1,44	-	1,29	-	-	-	-	1,20	1,37	
		max	1,37	1,58	-	1,92	1,43	1,46	1,54	-	1,82	-	1,50	1,30	1,62	-	1,33	-	-	-	-	1,20	1,54	+12%
	MUH	min	1,33	1,42	-	1,13	1,28	1,25	1,14	-	1,67	-	0,98	1,18	1,40	-	1,25	-	-	-	-	1,20	1,25	-9%
		average	1,35	1,50	-	1,29	1,37	1,29	1,34	-	1,78	-	1,26	1,24	1,51	-	1,29	-	-	-	-	1,20	1,37	-0%
		max	1,37	1,58	-	1,92	1,43	1,32	1,54	-	1,85	-	1,50	1,30	1,62	-	1,33	-	-	-	-	1,20	1,53	+12%
	deviation from "common"		-1%	+10%		-6%	-0%	-1%	-3%		+28%		-8%	-8%	+8%		-6%					-12%	0%	
B_NC_LT	SUH	min	1,25	-	-	1,13	1,25	1,23	-	-	1,54	-	1,11	-	-	1,17	-	-	1,22	1,22	-	1,10	1,21	-5%
		average	1,28	-	-	1,22	1,29	1,29	-	-	1,58	-	1,14	-	-	1,19	-	-	1,49	1,22	-	1,10	1,28	
		max	1,30	-	-	1,31	1,33	1,35	-	-	1,61	-	1,19	-	-	1,21	-	-	1,75	1,22	-	1,10	1,37	+8%
	MUH	min	1,25	-	-	1,13	1,25	1,18	-	-	1,54	-	1,11	-	-	1,15	-	-	-	1,22	-	1,10	1,20	-4%
		average	1,28	-	-	1,22	1,29	1,23	-	-	1,59	-	1,14	-	-	1,17	-	-	-	1,22	-	1,10	1,25	-2%
		max	1,30	-	-	1,31	1,33	1,29	-	-	1,63	-	1,19	-	-	1,19	-	-	-	1,22	-	1,10	1,32	+6%
	deviation from "common"		+1%			-4%	+2%	-0%			+25%		-10%			-7%			+18%	-3%		-13%	0%	
B_C	SUH	min	1,12	1,04	1,06	1,13	1,03	1,08	1,02	1,00	1,20	1,19	0,76	1,05	1,11	1,14	1,03	1,05	1,04	1,07	-	0,98	1,04	-6%
		average	1,13	1,05	1,06	1,22	1,06	1,16	1,04	1,00	1,29	1,32	0,97	1,05	1,11	1,14	1,04	1,05	1,17	1,07	-	1,08	1,11	
		max	1,14	1,07	1,06	1,31	1,09	1,21	1,05	1,00	1,36	1,45	1,15	1,05	1,11	1,14	1,05	1,05	1,43	1,07	-	1,18	1,17	+6%
	MUH	min	1,12	1,04	1,06	1,13	1,03	1,06	1,05	1,00	1,20	1,19	0,76	1,02	1,11	1,14	1,03	1,05	1,04	1,07	-	0,98	1,04	-5%
		average	1,13	1,05	1,06	1,22	1,06	1,13	1,05	1,00	1,33	1,32	0,97	1,03	1,11	1,14	1,04	1,05	1,08	1,07	-	1,08	1,10	-0%
		max	1,14	1,07	1,06	1,31	1,09	1,17	1,05	1,00	1,47	1,45	1,15	1,03	1,11	1,14	1,05	1,05	1,12	1,07	-	1,18	1,16	+5%
	deviation from "common"		+2%	-4%	-4%	+11%	-4%	+4%	-5%	-9%	+19%	+20%	-12%	-6%	+1%	+3%	-6%	-5%	+2%	-3%		-2%	0%	
B_WP	SUH	min	1,34	-	1,34	-	1,33	1,37	-	1,05	1,36	-	-	-	-	1,40	-	1,18	1,33	1,18	1,25	1,20	1,26	-5%
		average	1,34	-	1,34	-	1,33	1,37	-	1,05	1,36	-	-	-	-	1,49	-	1,18	1,43	1,18	1,25	1,60	1,33	
		max	1,34	-	1,34	-	1,33	1,37	-	1,05	1,36	-	-	-	-	1,69	-	1,18	1,59	1,18	1,25	2,00	1,44	+8%
	MUH	min	1,34	-	1,34	-	1,33	1,25	-	-	1,34	-	-	-	-	1,40	-	1,18	1,18	1,18	1,25	1,20	1,26	-4%
		average	1,34	-	1,34	-	1,33	1,25	-	-	1,34	-	-	-	-	1,50	-	1,18	1,18	1,18	1,25	1,60	1,32	-1%
		max	1,34	-	1,34	-	1,33	1,25	-	-	1,34	-	-	-	-	1,67	-	1,18	1,18	1,18	1,25	2,00	1,42	+8%
	deviation from "common"		+1%		+1%		+1%	-1%		-21%	+2%					+13%		-11%	-1%	-11%	-5%	+21%	0%	
G_IWH	SUH	min	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,25	-0%
		average	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,26	

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
		max	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,26	+0%
		min	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,25	-0%
	MUH	average	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,26	0%
		max	-	-	-	1,24	-	-	-	-	-	-	1,27	-	-	-	-	-	-	-	-	-	1,26	+0%
	deviation from "common"					-1%							+1%										0%	
		min	-	-	-	-	-	1,18	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,20	-3%
	SUH	average	-	-	-	-	-	1,23	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,24	
		max	-	-	-	-	-	1,27	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,26	+2%
G_IWH_NC		min	-	-	-	-	-	1,18	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,20	-3%
	MUH	average	-	-	-	-	-	1,23	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,24	0%
		max	-	-	-	-	-	1,27	-	-	-	-	1,25	-	-	-	-	-	-	-	-	-	1,26	+2%
	deviation from "common"							-1%					+1%										0%	
		min	-	-	-	-	-	1,09	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,10	-2%
	SUH	average	-	-	-	-	-	1,14	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,13	
		max	-	-	-	-	-	1,18	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,16	+3%
G_IWH_C		min	-	-	-	-	-	1,09	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,10	-2%
	MUH	average	-	-	-	-	-	1,14	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,13	0%
		max	-	-	-	-	-	1,18	-	-	-	-	1,12	-	-	-	-	-	-	-	-	-	1,16	+3%
	deviation from "common"							+1%					-1%										0%	
		min	1,59	-	-	1,41	-	1,40	-	1,11	-	-	1,46	-	1,39	-	-	-	-	-	-	1,18	1,33	-3%
	SUH	average	1,59	-	-	1,41	-	1,40	-	1,13	-	-	1,46	-	1,39	-	-	-	-	-	-	1,18	1,37	
		max	1,59	-	-	1,41	-	1,40	-	1,15	-	-	1,46	-	1,39	-	-	-	-	-	-	1,18	1,40	+2%
G_SH		min	1,59	-	-	1,41	-	1,40	-	1,11	-	-	1,46	-	-	-	-	-	-	-	-	1,18	1,32	-3%
	MUH	average	1,59	-	-	1,41	-	1,40	-	1,13	-	-	1,46	-	-	-	-	-	-	-	-	1,18	1,36	-0%
		max	1,59	-	-	1,41	-	1,40	-	1,15	-	-	1,46	-	-	-	-	-	-	-	-	1,18	1,40	+3%
	deviation from "common"		+17%			+3%		+3%		-17%			+7%		+2%							-13%	0%	
		min	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	0,29	-	-	-	-	1,00	1,00	-	1,00	-	0,86	-12%
	SUH	average	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	0,74	-	-	-	-	1,00	1,00	-	1,00	-	0,98	
		max	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	1,05	-	-	-	-	1,00	1,00	-	1,00	-	1,01	+4%
E		min	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	0,28	-	-	-	-	1,00	1,00	-	1,00	-	0,86	-12%
	MUH	average	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	0,75	-	-	-	-	1,00	1,00	-	1,00	-	0,98	+0%
		max	1,01	1,00	1,00	1,03	-	-	1,00	-	-	-	1,05	-	-	-	-	1,00	1,00	-	1,00	-	1,01	+4%
	deviation from "common"		+4%	+2%	+2%	+6%			+2%				-24%					+2%	+2%		+2%		0%	
		min	-	-	-	1,00	-	1,00	-	-	-	-	1,00	-	-	-	-	1,02	-	-	1,02	-	1,01	-1%
	SUH	average	-	-	-	1,01	-	1,00	-	-	-	-	1,06	-	-	-	-	1,02	-	-	1,02	-	1,02	
		max	-	-	-	1,02	-	1,00	-	-	-	-	1,11	-	-	-	-	1,02	-	-	1,02	-	1,05	+3%
E_Immersion		min	-	-	-	1,00	-	1,00	-	-	-	-	1,00	-	-	-	-	1,02	-	-	1,02	-	1,01	-1%
	MUH	average	-	-	-	1,01	-	1,00	-	-	-	-	1,06	-	-	-	-	1,02	-	-	1,02	-	1,02	0%
		max	-	-	-	1,02	-	1,00	-	-	-	-	1,11	-	-	-	-	1,02	-	-	1,02	-	1,05	+3%
	deviation from "common"					-1%		-2%					+3%					-0%			-0%		0%	
		min	-	-	-	-	1,00	1,00	-	-	-	1,00	1,00	-	1,00	-	-	-	1,01	-	-	-	1,00	-0%
	SUH	average	-	-	-	-	1,00	1,00	-	-	-	1,00	1,03	-	1,00	-	-	-	1,01	-	-	-	1,01	
		max	-	-	-	-	1,00	1,00	-	-	-	1,00	1,05	-	1,00	-	-	-	1,01	-	-	-	1,02	+1%
E_Storage		min	-	-	-	-	1,00	1,00	-	-	-	1,00	1,00	-	1,00	-	-	-	1,01	-	-	-	1,00	-0%
	MUH	average	-	-	-	-	1,00	1,00	-	-	-	1,00	1,03	-	1,00	-	-	-	1,01	-	-	-	1,01	0%
		max	-	-	-	-	1,00	1,00	-	-	-	1,00	1,05	-	1,00	-	-	-	1,01	-	-	-	1,02	+1%
	deviation from "common"						-1%	-1%				-1%	+2%		-1%				+0%				0%	
		min	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,01	-0%
	SUH	average	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,01	
		max	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,02	+1%
E_UnderFloor		min	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,01	-0%
	MUH	average	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,01	0%
		max	-	-	-	1,00	-	-	-	-	1,02	1,00	1,00	-	-	-	-	-	1,05	-	-	-	1,02	+1%
	deviation from "common"					-1%					+1%	-1%	-1%						+4%				0%	
E_SH	SUH	min	-	-	-	1,00	-	1,00	-	1,00	1,04	-	1,00	-	1,00	-	-	-	-	1,03	-	-	1,01	-0%

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
		average	-	-	-	1,00	-	1,00	-	1,00	1,05	-	1,00	-	1,00	-	-	-	-	1,03	-	-	1,01	
		max	-	-	-	1,00	-	1,00	-	1,00	1,06	-	1,00	-	1,00	-	-	-	-	1,03	-	-	1,02	+1%
		min	-	-	-	1,00	-	1,00	-	1,00	1,04	-	1,00	-	-	-	-	-	-	1,03	-	-	1,01	-0%
	MUH	average	-	-	-	1,00	-	1,00	-	1,00	1,05	-	1,00	-	-	-	-	-	-	1,03	-	-	1,01	+0%
		max	-	-	-	1,00	-	1,00	-	1,00	1,06	-	1,00	-	-	-	-	-	-	1,03	-	-	1,02	+1%
	deviation from "common"					-1%		-1%		-1%	+4%		-1%		-1%					+2%			0%	
		min	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,46	-6%
	SUH	average	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,49	
		max	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,51	+5%
HP		min	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,46	-6%
	MUH	average	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,49	0%
		max	-	-	-	0,37	-	-	-	-	-	-	0,50	-	-	-	-	0,59	-	-	-	-	0,51	+5%
	deviation from "common"					-24%							+3%					+21%					0%	
		min	0,29	0,37	0,30	-	0,35	0,35	0,29	0,37	0,39	0,40	0,15	-	0,26	0,41	-	0,49	-	0,33	0,40	0,36	0,33	-10%
	SUH	average	0,32	0,37	0,30	-	0,39	0,40	0,29	0,44	0,41	0,40	0,27	-	0,32	0,44	-	0,49	-	0,33	0,40	0,36	0,37	
		max	0,34	0,37	0,30	-	0,42	0,45	0,29	0,50	0,43	0,40	0,59	-	0,38	0,49	-	0,49	-	0,33	0,40	0,36	0,42	+13%
HP_Air		min	0,29	0,37	0,30	-	0,35	0,35	0,29	0,37	-	0,40	0,15	-	0,26	0,41	-	0,49	-	0,33	0,40	0,36	0,33	-10%
	MUH	average	0,32	0,37	0,30	-	0,39	0,40	0,29	0,44	-	0,40	0,27	-	0,26	0,45	-	0,49	-	0,33	0,40	0,36	0,36	-2%
		max	0,34	0,37	0,30	-	0,42	0,45	0,29	0,50	-	0,40	0,59	-	0,26	0,47	-	0,49	-	0,33	0,40	0,36	0,41	+13%
	deviation from "common"		-14%	+1%	-18%		+5%	+9%	-22%	+20%	+11%	+9%	-26%		-21%	+21%		+34%		-10%	+9%	-3%	0%	
		min	0,25	0,26	0,25	-	0,25	0,29	0,25	-	0,27	-	0,13	-	0,36	0,29	-	0,43	0,29	0,25	0,33	0,29	0,27	-10%
	SUH	average	0,25	0,47	0,25	-	0,29	0,32	0,25	-	0,27	-	0,17	-	0,36	0,29	-	0,43	0,29	0,25	0,33	0,29	0,30	
		max	0,25	0,70	0,25	-	0,32	0,36	0,25	-	0,27	-	0,21	-	0,36	0,29	-	0,43	0,29	0,25	0,33	0,29	0,35	+15%
HP_Ground		min	0,25	0,26	0,25	-	0,25	0,29	0,25	-	-	-	0,13	-	-	0,29	-	0,43	0,29	0,25	0,33	0,29	0,26	-12%
	MUH	average	0,25	0,47	0,25	-	0,29	0,32	0,25	-	-	-	0,17	-	-	0,29	-	0,43	0,29	0,25	0,33	0,29	0,30	-1%
		max	0,25	0,70	0,25	-	0,32	0,36	0,25	-	-	-	0,21	-	-	0,29	-	0,43	0,29	0,25	0,33	0,29	0,35	+18%
	deviation from "common"		-16%	+57%	-16%		-4%	+8%	-16%		-9%		-44%		+20%	-3%		+44%	-3%	-16%	+10%	-4%	0%	
		min	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	0,38	-	0,33	-	0,34	-4%
	SUH	average	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	0,38	-	0,33	-	0,35	
		max	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	0,38	-	0,33	-	0,36	+3%
HP_ExhAir		min	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	-	-	0,33	-	0,33	-4%
	MUH	average	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	-	-	0,33	-	0,34	-3%
		max	-	-	-	-	-	-	-	-	0,40	-	0,29	-	-	-	-	-	-	-	0,33	-	0,36	+5%
	deviation from "common"										+17%		-17%						+10%		-4%		0%	
		min	0,25	0,24	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	-13%
	SUH	average	0,25	0,39	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,28	
		max	0,25	0,53	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,36	+28%
HP_Water		min	0,25	0,24	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	-13%
	MUH	average	0,25	0,39	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,28	0%
		max	0,25	0,53	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,36	+28%
	deviation from "common"		-12%	+36%	-12%								-12%										0%	
		min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FALSCH	
	SUH	average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,00	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FALSCH	
HP_Other		min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FALSCH	
	MUH	average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,00	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FALSCH	
	deviation from "common"																							
		min	-	1,34	-	2,06	-	-	-	-	-	-	1,10	-	1,53	-	-	-	-	-	-	-	1,42	-15%
	SUH	average	-	1,37	-	2,51	-	-	-	-	-	-	1,33	-	1,53	-	-	-	-	-	-	-	1,68	
		max	-	1,39	-	2,96	-	-	-	-	-	-	1,57	-	1,53	-	-	-	-	-	-	-	2,08	+24%
Stove		min	-	1,34	-	2,06	-	-	-	-	-	-	1,10	-	-	-	-	-	-	-	-	-	1,40	-19%
	MUH	average	-	1,37	-	2,51	-	-	-	-	-	-	1,33	-	-	-	-	-	-	-	-	-	1,74	+3%
		max	-	1,39	-	2,96	-	-	-	-	-	-	1,57	-	-	-	-	-	-	-	-	-	2,22	+28%
	deviation from "common"			-20%		+47%							-22%		-11%								0%	

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
		min	1,52	1,41	-	2,06	-	1,40	-	1,11	1,96	-	1,07	-	-	-	-	-	1,19	-	-	-	1,42	-9%
	SUH	average	1,52	1,46	-	2,51	-	1,40	-	1,13	1,96	-	1,30	-	-	-	-	-	1,26	-	-	-	1,57	
		max	1,52	1,51	-	2,96	-	1,40	-	1,15	1,96	-	1,53	-	-	-	-	-	1,33	-	-	-	1,81	+16%
Stove_L		min	1,52	1,41	-	2,06	-	1,40	-	1,11	1,96	-	1,07	-	-	-	-	-	1,19	-	-	-	1,42	-9%
	MUH	average	1,52	1,46	-	2,51	-	1,40	-	1,13	1,96	-	1,30	-	-	-	-	-	1,26	-	-	-	1,57	0%
		max	1,52	1,51	-	2,96	-	1,40	-	1,15	1,96	-	1,53	-	-	-	-	-	1,33	-	-	-	1,81	+16%
	deviation from "common"		-3%	-7%		+60%		-11%		-28%	+25%		-17%						-20%				0%	
		min	1,67	1,56	1,40	2,06	-	1,60	-	1,05	1,70	-	1,43	-	-	1,79	-	1,30	1,67	2,37	-	-	1,59	-7%
	SUH	average	1,96	1,73	1,40	2,06	-	1,60	-	1,05	1,70	-	1,43	-	-	2,12	-	1,43	1,67	2,40	-	-	1,71	
		max	2,22	1,81	1,40	2,06	-	1,60	-	1,05	1,70	-	1,43	-	-	2,50	-	1,56	1,67	2,42	-	-	1,84	+7%
Stove_S		min	1,67	1,56	1,40	2,06	-	1,60	-	1,05	-	-	1,43	-	-	1,79	-	1,30	1,67	2,37	-	-	1,58	-8%
	MUH	average	1,96	1,73	1,40	2,06	-	1,60	-	1,05	-	-	1,43	-	-	2,12	-	1,43	1,67	2,40	-	-	1,71	+0%
		max	2,22	1,81	1,40	2,06	-	1,60	-	1,05	-	-	1,43	-	-	2,50	-	1,56	1,67	2,42	-	-	1,85	+8%
	deviation from "common"		+15%	+1%	-18%	+20%		-7%		-39%	-1%		-17%			+24%		-17%	-2%	+40%			0%	
		min	-	-	-	2,44	-	-	-	-	-	-	2,00	-	3,33	-	-	2,56	3,33	-	-	-	2,61	-19%
	SUH	average	-	-	-	3,44	-	-	-	-	-	-	3,50	-	3,33	-	-	2,56	3,33	-	-	-	3,23	
		max	-	-	-	4,44	-	-	-	-	-	-	5,00	-	3,33	-	-	2,56	3,33	-	-	-	3,94	+22%
OpenFire		min	-	-	-	2,44	-	-	-	-	-	-	2,00	-	-	-	-	2,56	3,33	-	-	-	2,47	-23%
	MUH	average	-	-	-	3,44	-	-	-	-	-	-	3,50	-	-	-	-	2,56	3,33	-	-	-	3,21	-1%
		max	-	-	-	4,44	-	-	-	-	-	-	5,00	-	-	-	-	2,56	3,33	-	-	-	4,07	+27%
	deviation from "common"					+7%							+9%		+4%			-20%	+3%				0%	
		min	1,02	-	-	-	1,02	1,02	1,03	-	-	-	1,05	-	-	-	-	1,02	1,01	1,18	1,33	1,00	1,06	-3%
	SUH	average	1,02	-	-	-	1,04	1,02	1,05	-	-	-	1,15	-	-	-	-	1,02	1,05	1,29	1,33	1,00	1,10	
		max	1,02	-	-	-	1,05	1,02	1,06	-	-	-	1,25	-	-	-	-	1,02	1,08	1,52	1,33	1,00	1,17	+7%
TS		min	1,02	-	1,03	-	1,02	1,02	1,03	-	1,19	-	1,05	1,01	-	1,09	-	1,02	1,01	1,18	1,33	1,00	1,07	-3%
	MUH	average	1,02	-	1,05	-	1,04	1,02	1,05	-	1,30	-	1,15	1,01	-	1,09	-	1,02	1,05	1,29	1,33	1,00	1,10	+0%
		max	1,02	-	1,07	-	1,05	1,02	1,06	-	1,43	-	1,25	1,01	-	1,09	-	1,02	1,08	1,52	1,33	1,00	1,17	+6%
	deviation from "common"		-7%		-4%		-6%	-7%	-4%		+18%		+5%	-8%		-1%		-7%	-5%	+17%	+21%	-9%	0%	
		min	-	-	-	1,67	1,67	1,48	-	-	-	1,33	1,18	-	-	-	-	-	-	-	-	-	1,42	-5%
	SUH	average	-	-	-	1,67	1,67	1,58	-	-	-	1,33	1,24	-	-	-	-	-	-	-	-	-	1,50	
		max	-	-	-	1,67	1,67	1,67	-	-	-	1,33	1,30	-	-	-	-	-	-	-	-	-	1,55	+4%
CHP		min	-	-	-	1,67	1,67	1,48	-	-	-	1,33	1,18	-	-	-	-	-	-	-	-	-	1,42	-5%
	MUH	average	-	-	-	1,67	1,67	1,58	-	-	-	1,33	1,24	-	-	-	-	-	-	-	-	-	1,50	0%
		max	-	-	-	1,67	1,67	1,67	-	-	-	1,33	1,30	-	-	-	-	-	-	-	-	-	1,55	+4%
	deviation from "common"					+12%	+12%	+5%				-11%	-17%										0%	
		min	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
	SUH	average	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
		max	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
Solar		min	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
	MUH	average	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
		max	0,00	-	-	0,00	-	0,00	0,00	-	-	-	0,00	-	-	0,00	-	0,00	-	-	0,00	0,00	0,00	
	deviation from "common"																							

Annotation: In case of Greece ("GR") values used for average buildings are included in the analyses.

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Table 12: Deviations from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
B	+4%			+4%	+16%						+2%					-13%		+5%	-18%	
B_NC	+0%	+6%	-3%				-15%	-14%			+16%			+1%		-13%	-11%	+29%	-8%	
B_NC_CT	-1%	+10%		-6%	-0%	-1%	-3%		+28%		-8%	-8%	+8%		-6%					-8%
B_NC_LT	+1%			-4%	+2%	-0%			+25%		-10%			-7%			+18%	-3%		
B_C	+2%	-4%	-4%	+11%	-4%	+4%	-5%	-9%	+19%	+20%	-12%	-6%	+1%	+3%	-6%	-5%	+2%	-3%		-6%
B_WP	+1%		+1%		+1%	-1%		-21%	+2%					+13%		-11%	-1%	-11%	-5%	
G_IWH				-1%							+1%									
G_IWH_NC						-1%					+1%									
G_IWH_C						+1%					-1%									
G_SH	+17%			+3%		+3%		-17%			+7%		+2%							
E	+4%	+2%	+2%	+6%			+2%				-24%					+2%	+2%		+2%	
E_Immersion				-1%		-2%					+3%					-0%			-0%	
E_Storage					-1%	-1%				-1%	+2%		-1%				+0%			
E_UnderFloor				-1%					+1%	-1%	-1%						+4%			
E_SH				-1%		-1%		-1%	+4%		-1%		-1%					+2%		
HP				-24%							+3%					+21%				
HP_Air	-14%	+1%	-18%		+5%	+9%	-22%	+20%	+11%	+9%	-26%		-21%	+21%		+34%		-10%	+9%	
HP_Ground	-16%	+57%	-16%		-4%	+8%	-16%		-9%		-44%		+20%	-3%		+44%	-3%	-16%	+10%	
HP_ExhAir									+17%		-17%						+10%		-4%	
HP_Water	-12%	+36%	-12%								-12%									
HP_Other																				
Stove		-20%		+47%							-22%		-11%							
Stove_L	-3%	-7%		+60%		-11%		-28%	+25%		-17%						-20%			
Stove_S	+15%	+1%	-18%	+20%		-7%		-39%	-1%		-17%			+24%		-17%	-2%	+40%		
OpenFire				+7%							+9%		+4%			-20%	+3%			
TS	-7%		-4%		-6%	-7%	-4%		+18%		+5%	-8%		-1%		-7%	-5%	+17%	+21%	-8%
CHP				+12%	+12%	+5%				-11%	-17%									
Solar																				

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Table 13: Energy expenditure factors heat generation (heating systems) / merged and condensed values (data source: Tab.System.HG)

heat generator type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
B_NC	boiler, non-condensing	poor	1,37	2,00	1,40	1,92	1,43	1,46	1,54	1,15	1,85		1,53	1,30	1,62	1,57	1,33	1,18	1,75	1,86	1,40	1,35	1,76	+35%
		medium	1,31	1,45	1,27	1,25	1,33	1,31	1,25	1,13	1,67		1,31	1,26	1,48	1,25	1,29	1,15	1,27	1,45	1,21	1,22	1,31	
		high	1,25	1,13	1,12	1,13	1,25	1,18	1,07	1,11	1,54		(0,98)	1,18	1,25	1,15	1,25	1,11	1,16	1,22	1,11	1,10	1,13	-14%
	consideration in "common"		1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	n=18	
B_C	boiler, condensing	poor	1,14	1,07	1,06	1,31	1,09	1,21	1,05	1,00	1,47	1,45	1,15	1,05	1,11	1,14	1,05	1,05	1,43	1,07		1,18	1,32	+18%
		medium	1,13	1,05	1,06	1,22	1,06	1,14	1,04	1,00	1,31	1,32	(0,97)	1,04	1,11	1,14	1,04	1,05	1,12	1,07		1,08	1,11	
		high	1,12	1,04	1,06	1,13	1,03	1,06	1,02	1,00	1,20	1,19	(0,76)	1,02	1,11	1,14	1,03	1,05	1,04	1,07		(0,98)	1,04	-7%
	consideration in "common"		1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1			n=17	
B_WP	wood-pellets boiler	poor	1,34		1,34		1,33	1,37		1,05	1,36					1,69		1,18	1,59	1,18	1,25	2,00	1,69	+29%
		medium	1,34		1,34		1,33	1,31		1,05	1,35					1,49		1,18	1,31	1,18	1,25	1,60	1,31	
		high	1,34		1,34		1,33	1,25		1,05	1,34					1,40		1,18	1,18	1,18	1,25	1,20	1,15	-12%
	consideration in "common"		1		1		1	1		1	1					1		1	1	1	1	1	n=12	
G_IWH_NC	gas-fired instantaneous water heater, non-condensing	poor						1,27					1,25										1,26	+2%
		medium						1,23					1,25										1,24	
		high						1,18					1,25										1,20	-3%
	consideration in "common"							1					1										n=2	
G_IWH_C	gas-fired instantaneous water heater, condensing	poor						1,18					1,12										1,16	+3%
		medium						1,14					1,12										1,13	
		high						1,09					1,12										1,10	-3%
	consideration in "common"							1					1										n=2	
G_SH	gas-fired space heater	poor	1,59			1,41		1,40		1,15			1,46		1,39							1,18	1,48	+8%
		medium	1,59			1,41		1,40		1,13			1,46		1,39							1,18	1,37	
		high	1,59			1,41		1,40		1,11			1,46		1,39							1,18	1,24	-9%
	consideration in "common"		1			1		1		1			1		1							1	n=7	
E_Immersion	electric immersion heater	poor				1,02		1,00					1,11					1,02			1,02		1,07	+5%
		medium				1,01		1,00					1,06					1,02			1,02		1,02	
		high				1,00		1,00					1,00					1,02			1,02		1,00	-2%
	consideration in "common"					1		1					1					1			1		n=5	
E	direct electric heat generator	poor	1,01	1,00	1,00	1,03	1,00	1,00	1,00	1,00	1,06	1,00	1,05		1,00			1,00	1,05	1,03	1,00		1,04	+3%
		medium	1,01	1,00	1,00	1,01	1,00	1,00	1,00	1,00	1,04	1,00	0,93		1,00			1,00	1,02	1,03	1,00		1,01	
		high	1,01	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,02	1,00	0,28		1,00			1,00	1,00	1,03	1,00		1,00	-1%
	consideration in "common"		1	1	1	1	1	1	1	1	1	1			1			1	1	1	1		n=15	
HP_Air	heat pump, heat source external air	poor	0,34	0,37	0,30		0,42	0,45	0,29	0,50	0,43	0,40	0,59		0,38	0,49		0,49		0,33	0,40	0,36	0,50	+35%
		medium	0,32	0,37	0,30		0,39	0,40	0,29	0,44	0,41	0,40	0,27		0,29	0,44		0,49		0,33	0,40	0,36	0,37	
		high	0,29	0,37	0,30		0,35	0,35	0,29	0,37	0,39	0,40	0,15		0,26	0,41		0,49		0,33	0,40	0,36	0,25	-33%
	consideration in "common"		1	1	1		1	1	1	1	1	1	1		1	1		1		1	1	1	n=16	
HP_Ground	heat pump, heat source ground	poor	0,25	0,70	0,25		0,32	0,36	0,25		0,27		0,21		0,36	0,29		0,43	0,29	0,25	0,33	0,29	0,51	+70%
		medium	0,25	0,47	0,25		0,29	0,32	0,25		0,27		0,17		0,36	0,29		0,43	0,29	0,25	0,33	0,29	0,30	
		high	0,25	0,26	0,25		0,25	0,29	0,25		0,27		0,13		0,36	0,29		0,43	0,29	0,25	0,33	0,29	0,20	-32%
	consideration in "common"		1	1	1		1	1	1		1		1		1	1		1	1	1	1	1	n=15	
HP_ExhAir	heat pump, heat source exhaust air	poor									0,40		0,29						0,38		0,33		0,38	+8%
		medium									0,40		0,29						0,38		0,33		0,35	
		high									0,40		0,29						0,38		0,33		0,32	-9%
	consideration in "common"										1		1						1		1		n=4	

Stove	stove	poor	2,22	1,81	1,40	2,96		1,60		1,15	1,96		1,57		1,53	2,50		1,56	1,67	2,42				2,42	+44%
		medium	1,74	1,51	1,40	2,36		1,50		1,09	1,87		1,35		1,53	2,14		1,43	1,47	2,40				1,67	
		high	1,52	1,34	1,40	2,06		1,40		1,05	1,70		1,07		1,53	1,79		1,30	1,19	2,37				1,28	-23%
	consideration in "common"		1	1	1	1		1		1	1		1		1	1		1	1	1				n=13	
OpenFire	open fire	poor				4,44							5,00		3,33			2,56	3,33					4,37	+35%
		medium				3,44							3,50		3,33			2,56	3,33					3,23	
		high				2,44							2,00		3,33			2,56	3,33					2,37	-27%
	consideration in "common"					1							1		1			1	1					n=5	
TS	district heating transfer station	poor	1,02		1,07		1,05	1,02	1,06		1,43		1,25	1,01		1,09		1,02	1,08	1,52	1,33	1,00		1,33	+21%
		medium	1,02		1,05		1,04	1,02	1,05		1,30		1,15	1,01		1,09		1,02	1,05	1,29	1,33	1,00		1,10	
		high	1,02		1,03		1,02	1,02	1,03		1,19		1,05	1,01		1,09		1,02	1,01	1,18	1,33	1,00		1,04	-6%
	consideration in "common"		1		1		1	1	1		1		1	1		1		1	1	1	1	1		n=14	
CHP	combined heat and power generation	poor				1,67	1,67	1,67				1,33	1,30											1,60	+7%
		medium				1,67	1,67	1,58				1,33	1,24											1,50	
		high				1,67	1,67	1,48				1,33	1,18											1,32	-12%
	consideration in "common"					1	1	1				1	1											n=5	
Solar	thermal solar plant	poor	0,00			0,00		0,00	0,00				0,00			0,00		0,00			0,00	0,00		0,00	
		medium	0,00			0,00		0,00	0,00				0,00			0,00		0,00			0,00	0,00		0,00	
		high	0,00			0,00		0,00	0,00				0,00			0,00		0,00			0,00	0,00		0,00	
	consideration in "common"		1			1		1	1				1			1		1			1	1		n=9	

Energy expenditure factor electricity (CHP)

CHP	combined heat and power generation	poor	-	-	3,33	3,33	-	-	0,00	-	-	-	-	-	-	-	-	-	-	-	-	-		3,33	0%
		medium	-	-	3,33	3,33	-	-	0,00	-	-	-	-	-	-	-	-	-	-	-	-	-		3,33	
		high	-	-	3,33	3,33	-	-	0,00	-	-	-	-	-	-	-	-	-	-	-	-	-		3,33	0%
	consideration in "common"				1	1																		n=2	

Remarks

Merging of subdivisions of heat generators

B_NC: includes values of: B_NC, B_NC_CT, B_NC_LT
E: includes values of: E, E_Storage, E_Underfloor, E_SH
Stove: includes values of: Stove, Stove_L, Stove_S

Determination of common values

B_NC: GR: not considered / values are unrealistic low (referring to Hi instead of HS?)
B_C: SI and GR: not considered / values are unrealistic low (referring to Hi instead of HS?)
E: GR: not considered / values are unrealistic low (including heat pump systems?)

In case of Greece ("GR") values used for average buildings are included in the analyses.

Values in brackets: values below 1.0 are not plausible for boilers. This input is currently being revised by the respective partners.

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Figure 14: **Heat generation expenditure factors of heating systems (1)**

boilers: <B_NC> non-condensing, <B_C> condensing, <B_WP> wood-pellets

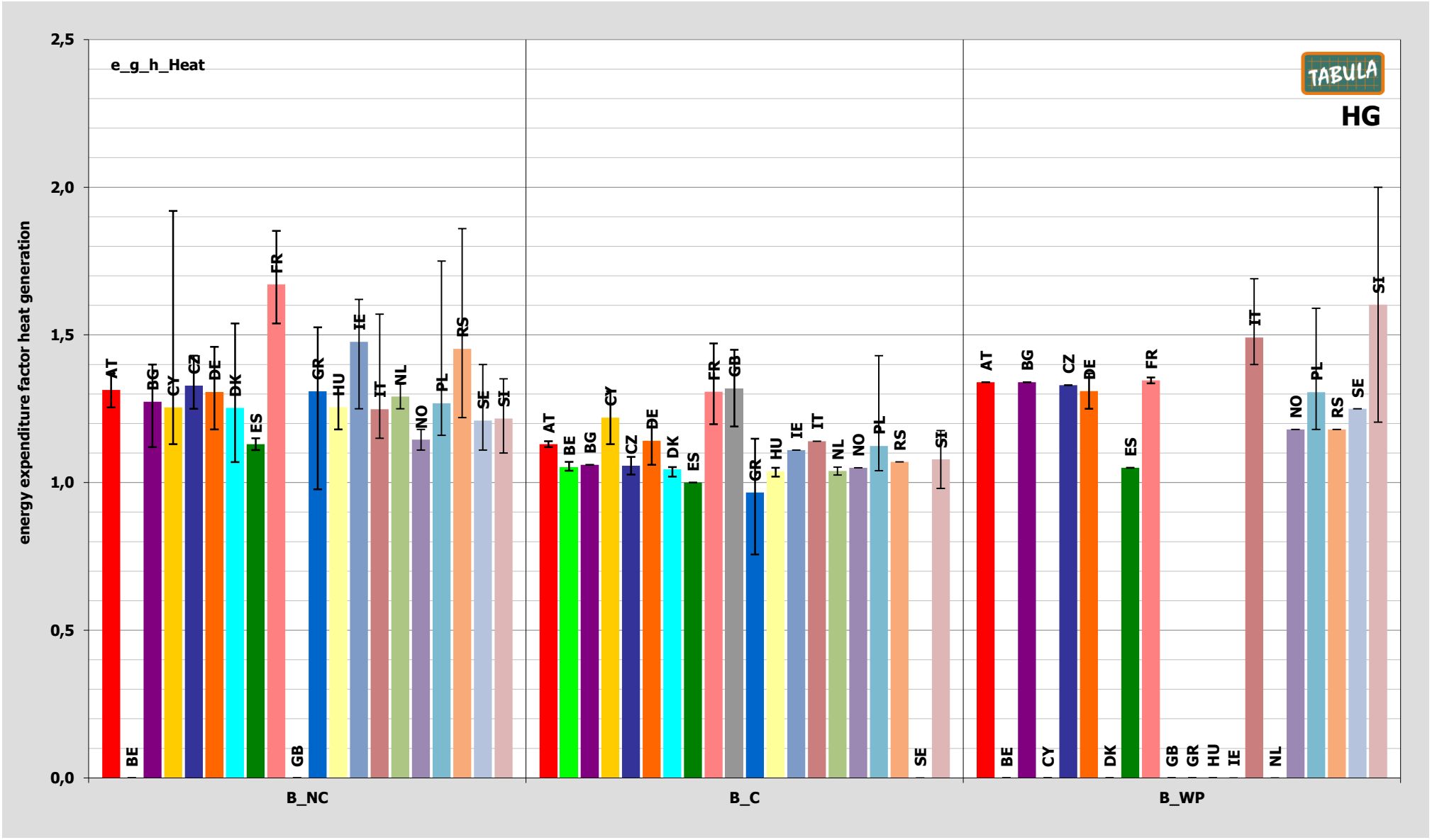

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Figure 15: **Heat generation expenditure factors of heating systems (2)**

electrical heat pumps, heat sources: <HP_Air> external air, <HP_Ground> ground, <HP_ExhAir> exhaust air

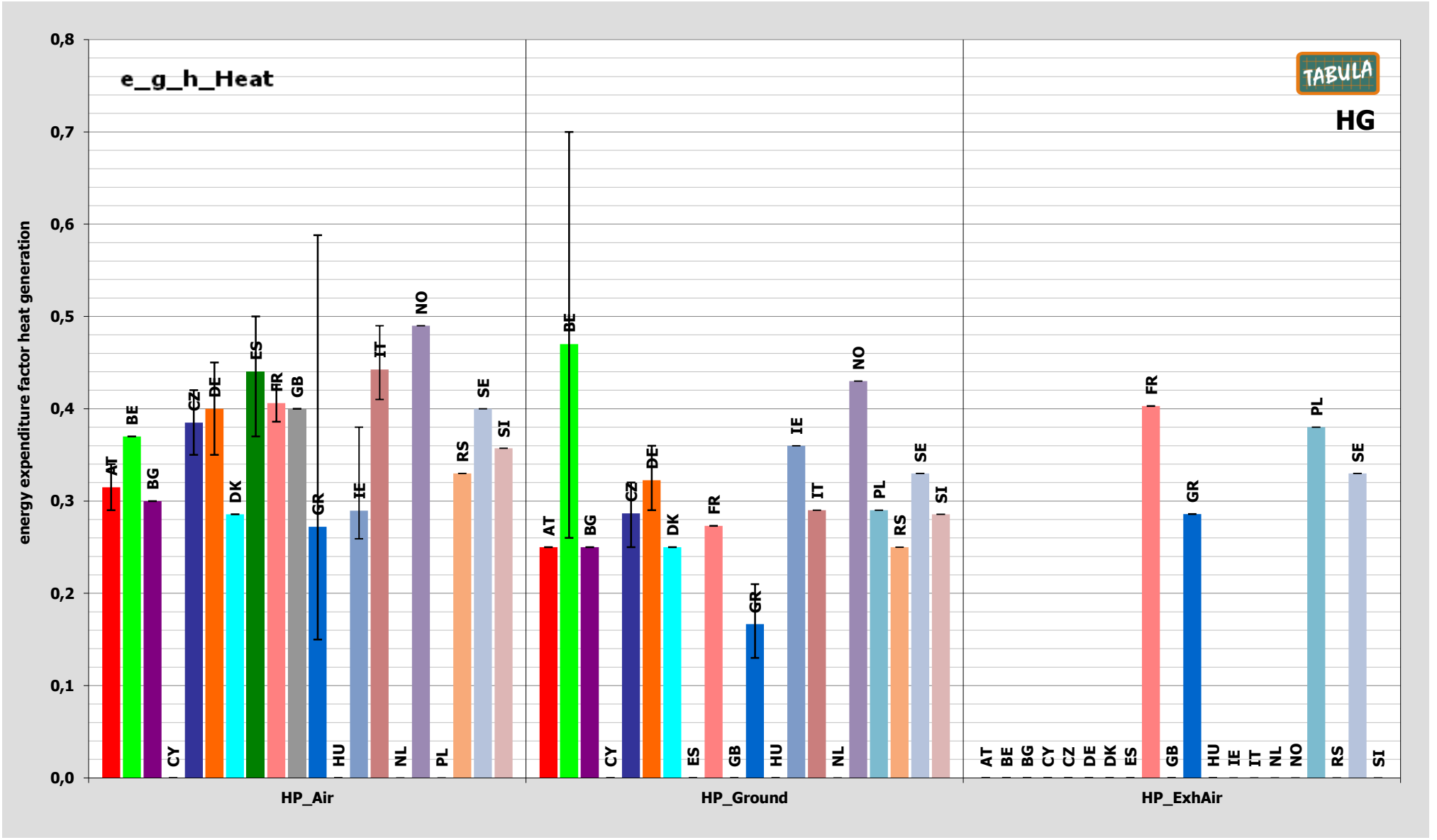

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Figure 16: Heat generation expenditure factors of heating systems (3)

gas-fired instantaneous water heaters: <G_IWH_NC> non-condensing, <G_IWH_C> condensing; <G_SH> gas-fired space heater

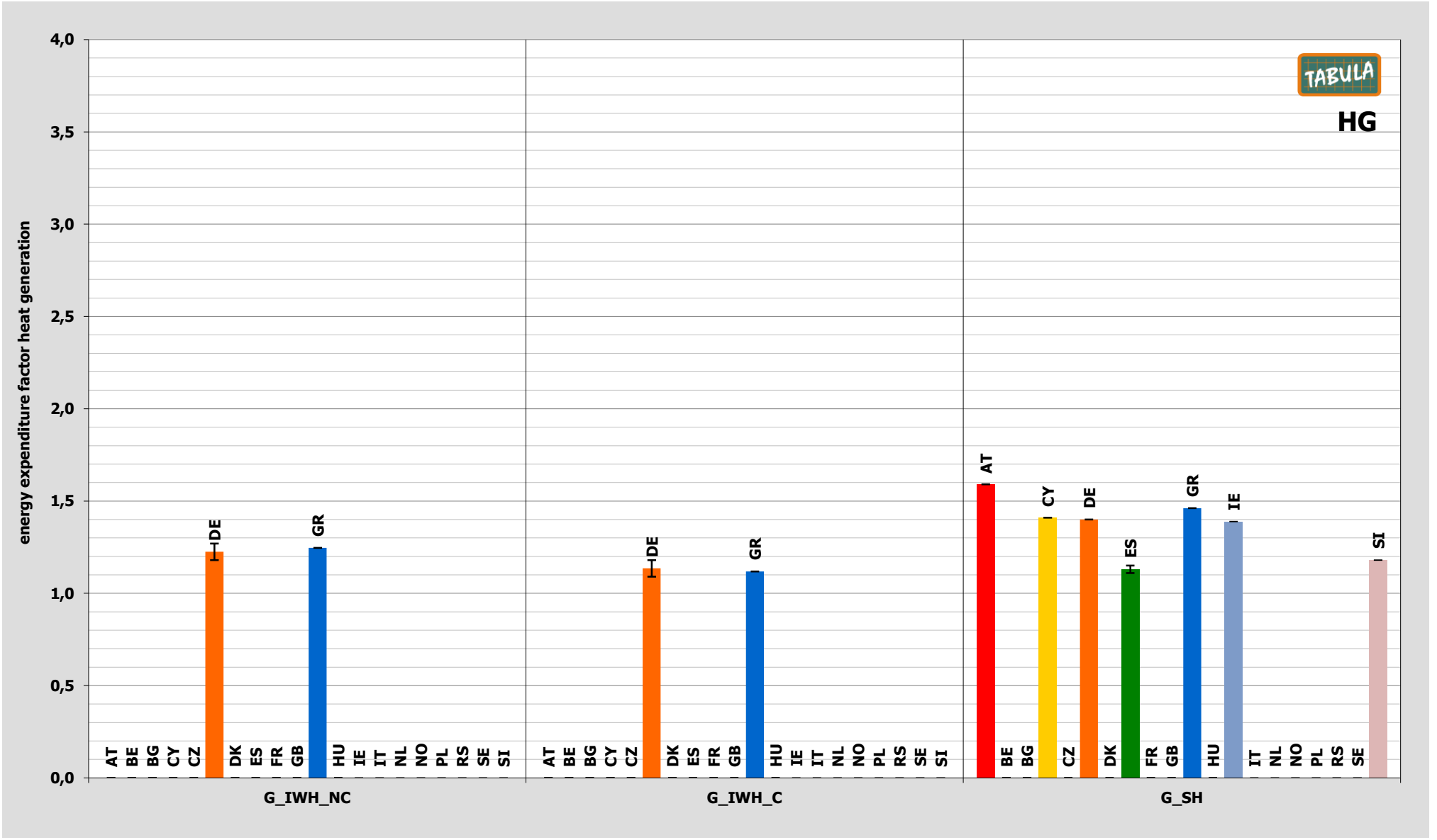

Figure 17: **Heat generation expenditure factors of heating systems (4)**

<Stoves> stoves; <OpenFire> open fires; <TS> district heating transfer station

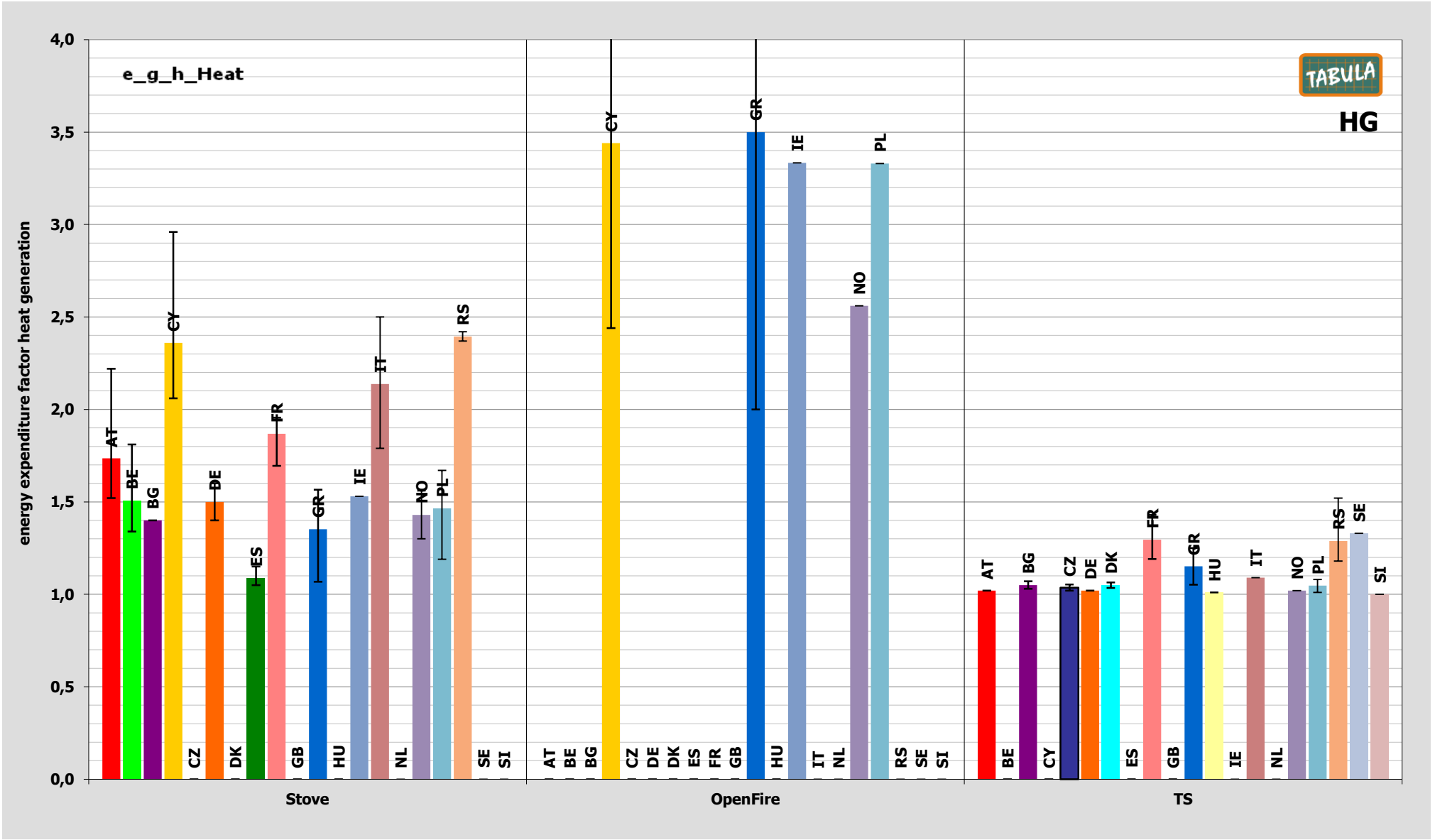

Table 14: Heat generation of heating systems / derived default values (simplified common values)

TABULA code	description	heat generation expenditure factor (heating systems)			electricity generation expenditure factor (heating systems)		
		delivered energy demand (H_S) devided by produced heat			electricity demand devided by produced heat		
		$e_{g,h}$			$e_{g,el,h}$		
		[-]			[-]		
	energy efficiency	**poor**	**standard**	**high**	**poor**	**standard**	**high**
B_NC	boiler, non-condensing	1,76	1,31	1,13	-	-	-
B_C	boiler, condensing	1,32	1,11	1,04	-	-	-
B_WP	wood-pellets boiler	1,69	1,31	1,15	-	-	-
G_IWH_NC	gas-fired instantaneous water heater, non-condensing	1,26	1,24	1,20	-	-	-
G_IWH_C	gas-fired instantaneous water heater, condensing	1,16	1,13	1,10	-	-	-
G_SH	gas-fired space heater	1,48	1,37	1,24	-	-	-
E_Immersion	electric immersion heater	1,07	1,02	1,00	-	-	-
E	direct electric heat generator	1,04	1,01	1,00	-	-	-
HP_Air	heat pump, heat source external air	0,50	0,37	0,25	-	-	-
HP_Ground	heat pump, heat source ground	0,51	0,30	0,20	-	-	-
HP_ExhAir	heat pump, heat source exhaust air	0,38	0,35	0,32	-	-	-
Stove	stove	2,42	1,67	1,28	-	-	-
OpenFire	open fire	4,37	3,23	2,37	-	-	-
TS	district heating transfer station	1,33	1,10	1,04	-	-	-
CHP	combined heat and power generation	1,60	1,50	1,32	3,33	3,33	3,33
Solar	thermal solar plant	0,00	0,00	0,00	-	-	-

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4.3 HS – Heating Systems / Heat Storage

Table 15: Annual heat loss of the space heating storage differentiated by country and by building size class (data source: Tab.System.HS)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
BS	SUH	min	-	-	-	6,5	-	-	2,0	-	8,1	5,7	2,5	-	-	1,4	2,0	3,0	-	2,5	2,0	0,0	2,98	-52%
		average	-	-	-	6,5	-	-	3,6	-	8,1	5,7	2,5	-	-	4,2	2,9	6,9	-	17,3	5,3	5,3	6,20	
		max	-	-	-	6,5	-	-	6,4	-	8,1	5,7	2,5	-	-	7,5	4,0	12,0	-	28,8	8,5	8,5	10,61	+71%
	MUH	min	-	-	-	6,5	-	1,0	0,3	-	0,9	5,7	2,5	-	1,3	0,8	0,3	3,0	-	0,1	2,0	2,0	1,89	-40%
		average	-	-	-	6,5	-	1,4	0,7	-	2,1	5,7	2,5	-	1,3	3,1	0,7	6,9	-	0,1	5,3	5,3	3,18	-49%
		max	-	-	-	6,5	-	1,8	1,3	-	3,2	5,7	2,5	-	1,3	6,6	1,3	12,0	-	0,1	8,5	8,5	5,09	+60%
	deviation from "common"					+39%			-55%		+8%	+22%	-47%			-22%	-62%	+47%		+86%	+12%	+12%	0%	
BS_E	SUH	min	7,1	5,6	9,5	2,2	9,5	4,5	-	-	2,4	-	1,8	-	-	-	-	-	-	-	-	0,0	4,26	-27%
		average	7,5	7,2	9,5	2,2	10,3	5,2	-	-	3,3	-	1,8	-	-	-	-	-	-	-	-	-	5,86	
		max	7,8	8,8	9,5	2,2	11,0	5,9	-	-	4,2	-	1,8	-	-	-	-	-	-	-	-	-	6,91	+18%
	MUH	min	7,1	5,6	9,5	2,2	9,5	4,5	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	5,25	-16%
		average	7,5	7,2	9,5	2,2	10,3	5,2	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	6,23	+6%
		max	7,8	8,8	9,5	2,2	11,0	5,9	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	7,25	+16%
	deviation from "common"		+23%	+19%	+57%	-64%	+70%	-14%					-70%										0%	
BS_Wood	SUH	min	7,1	10,1	8,5	2,2	7,9	7,2	-	-	-	-	1,8	-	-	-	-	-	2,5	7,0	-	0,0	4,94	-34%
		average	10,6	12,4	8,5	2,2	10,1	9,2	-	-	-	-	1,8	-	-	-	-	-	2,5	10,1	-	-	7,47	
		max	20,0	14,6	8,5	2,2	12,2	11,1	-	-	-	-	1,8	-	-	-	-	-	2,5	14,1	-	-	10,70	+43%
	MUH	min	7,1	10,1	8,5	2,2	7,9	7,2	-	-	-	-	1,8	-	-	-	-	-	2,5	-	-	-	5,46	-24%
		average	10,6	12,4	8,5	2,2	10,1	9,2	-	-	-	-	1,8	-	-	-	-	-	2,5	-	-	-	7,14	-4%
		max	20,0	14,6	8,5	2,2	12,2	11,1	-	-	-	-	1,8	-	-	-	-	-	2,5	-	-	-	10,32	+44%
	deviation from "common"		+45%	+69%	+16%	-70%	+38%	+25%					-75%						-66%				0%	
Other	SUH	min	-	-	-	0,0	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	0,0	0,45	-82%
		average	-	-	-	3,3	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	2,53	
		max	-	-	-	6,5	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	4,93	+95%
	MUH	min	-	-	-	0,0	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	0,60	-76%
		average	-	-	-	3,3	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	2,53	0%
		max	-	-	-	6,5	-	-	-	-	-	-	1,8	-	-	-	-	-	-	-	-	-	4,93	+95%
	deviation from "common"					+29%							-29%										0%	

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Table 16: Deviations from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
BS				+39%			-55%		+8%	+22%	-47%			-22%	-62%	+47%		+86%	+12%	+12%
BS_E	+23%	+19%	+57%	-64%	+70%	-14%					-70%									
BS_Wood	+45%	+69%	+16%	-70%	+38%	+25%					-75%						-66%			
Other				+29%							-29%									

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Table 17: Annual heat loss of the space heating storage / merged and condensed values (data source: Tab.System.HS)

heat storage type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
BS	buffer storage	poor	13,9	11,7	9,0	3,6	11,6	6,3	6,4		6,2	5,7	2,0		1,3	7,5	4,0	12,0	2,5	21,5	8,5	8,5	14,72	+173%
		medium	9,0	9,8	9,0	3,6	10,2	5,3	2,1		4,2	5,7	2,0		1,3	3,7	1,8	6,9	2,5	9,4	5,3	5,3	5,39	
		high	7,1	7,9	9,0	3,6	8,7	4,2	0,3		1,7	5,7	2,0		1,3	0,8	0,3	3,0	2,5	3,6	2,0	0,0	1,75	-68%
	consideration in "common"		1	1	1	1	1		1		1	1	1		1	1	1	1	1	1	1	1	n=17	

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Figure 18: Annual storage heat losses of heating systems

<BS> buffer storages

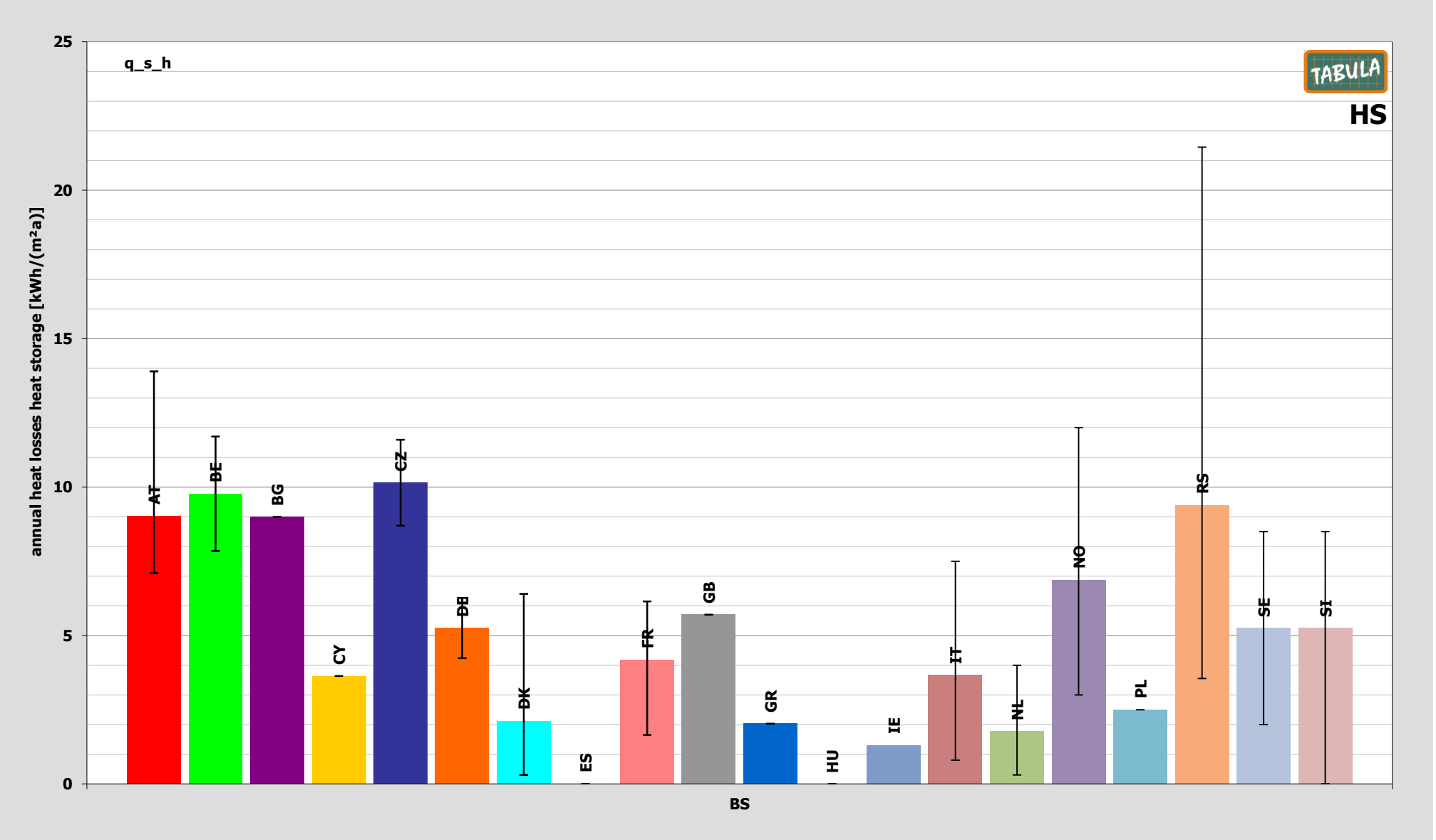

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Table 18: Annual heat loss of the space heating storage / derived default values (simplified common values)

TABULA code	description	heat loss of the space heating storage		
		annual heat losses during heating season per m² reference area		
		$q_{s,h}$		
		[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**
-	no heat storage	0,0	0,0	0,0
BS	buffer storage	14,7	5,4	1,7

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4.4 HD – Heating Systems / Heat Distribution

Table 19: Annual heat loss of the space heating distribution differentiated by country and by building size class (data source: Tab.System.HD)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
D	SUH	min	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	-	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		average	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	-	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		max	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	-	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
	MUH	min	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		average	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		max	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
	deviation from "common"																							
C	SUH	min	-	-	-	6,5	-	-	-	-	-	0,0	1,8	-	-	-	-	-	-	-	-	4,0	2,46	-36%
		average	-	-	-	6,5	-	-	-	-	-	0,0	3,4	-	-	-	-	-	-	-	-	9,3	3,85	
		max	-	-	-	6,5	-	-	-	-	-	0,0	5,0	-	-	-	-	-	-	-	-	14,0	5,10	+33%
	MUH	min	-	-	-	6,5	-	-	-	-	-	0,0	1,8	-	-	-	-	-	-	-	-	4,0	2,46	-36%
		average	-	-	-	6,5	-	-	-	-	-	0,0	3,4	-	-	-	-	-	-	-	-	9,3	3,85	0%
		max	-	-	-	6,5	-	-	-	-	-	0,0	5,0	-	-	-	-	-	-	-	-	14,0	5,10	+33%
	deviation from "common"					+69%						-100%	-12%									+143%		
C_Int	SUH	min	10,0	0,0	12,0	1,7	7,0	2,1	0,0	6,2	0,0	-	0,5	5,1	0,0	0,6	6,5	0,0	12,0	1,5	0,0	-	3,43	-40%
		average	20,0	0,0	12,0	4,1	7,0	4,7	0,0	6,2	0,0	-	3,3	8,8	9,5	12,3	6,5	0,0	12,0	1,5	0,0	-	5,68	
		max	30,0	0,0	12,0	6,5	7,0	6,3	0,0	6,2	0,0	-	6,2	12,5	20,1	32,1	6,5	0,0	12,0	1,5	0,0	-	8,36	+47%
	MUH	min	10,0	0,0	12,0	1,7	7,0	1,1	0,0	6,2	0,0	-	0,5	3,7	0,0	0,5	6,5	0,0	12,0	1,5	0,0	-	3,30	-28%
		average	20,0	0,0	12,0	4,1	7,0	3,7	0,0	6,2	0,0	-	3,3	8,1	1,7	0,5	6,5	0,0	12,0	1,5	0,0	-	4,56	-20%
		max	30,0	0,0	12,0	6,5	7,0	6,2	0,0	6,2	0,0	-	6,2	12,5	5,2	0,5	6,5	0,0	12,0	1,5	0,0	-	5,91	+30%
	deviation from "common"		+291%	-100%	+134%	-20%	+37%	-18%	-100%	+21%	-100%		-35%	+65%	+9%	+25%	+27%	-100%	+134%	-71%	-100%			
C_Ext	SUH	min	7,0	5,1	-	11,0	8,5	10,7	1,7	-	0,0	-	0,8	-	-	3,5	13,0	1,7	16,2	3,0	-	-	5,87	-47%
		average	7,0	11,1	-	12,2	18,7	21,7	7,5	-	0,0	-	9,0	-	-	23,8	13,0	7,5	19,9	3,5	-	-	11,05	
		max	7,0	17,0	-	13,3	33,0	31,7	22,1	-	0,0	-	22,6	-	-	53,1	13,0	22,1	23,5	4,0	-	-	18,74	+70%
	MUH	min	7,0	3,8	-	11,0	8,5	5,7	0,7	5,7	0,0	-	0,8	4,9	-	2,0	13,0	0,7	16,2	3,0	-	-	5,19	-44%
		average	7,0	8,3	-	12,2	18,7	15,6	3,0	12,7	0,0	-	9,0	7,6	-	15,6	13,0	3,0	19,9	3,5	-	-	9,31	-16%
		max	7,0	12,8	-	13,3	33,0	22,0	4,2	19,6	0,0	-	22,6	12,4	-	35,1	13,0	4,2	23,5	4,0	-	-	14,17	+52%
	deviation from "common"		-31%	-5%		+19%	+84%	+83%	-48%		-100%		-11%			+93%	+28%	-48%	+95%	-66%				
A	SUH	min	-	-	-	-	-	-	-	0,0	-	-	-	-	-	-	6,5	-	-	-	-	-	2,17	0%
		average	-	-	-	-	-	-	-	0,0	-	-	-	-	-	-	6,5	-	-	-	-	-	2,17	
		max	-	-	-	-	-	-	-	0,0	-	-	-	-	-	-	6,5	-	-	-	-	-	2,17	0%
	MUH	min	-	-	-	-	-	-	-	0,0	-	-	1,0	-	-	1,0	6,5	-	-	-	-	-	1,70	-53%
		average	-	-	-	-	-	-	-	0,0	-	-	1,8	-	-	9,7	6,5	-	-	-	-	-	3,59	+66%
		max	-	-	-	-	-	-	-	0,0	-	-	2,5	-	-	22,4	6,5	-	-	-	-	-	6,28	+75%
	deviation from "common"									-100%							+126%							

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Table 20: Deviations from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
D																				
C				+69%						-100%	-12%									+143%
C_Int	+291%	-100%	+134%	-20%	+37%	-18%	-100%	+21%	-100%		-35%	+65%	+9%	+25%	+27%	-100%	+134%	-71%	-100%	
C_Ext	-31%	-5%		+19%	+84%	+83%	-48%		-100%		-11%			+93%	+28%	-48%	+95%	-66%		
A								-100%							+126%					
Air_Int				-100%							+200%									
Air_Ext																				
MV_SupExh_Ext																				
MV_SupExh_Int																				
MV_SupExh_Int																				

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Table 21: Annual heat loss of the space heating distribution / merged and condensed values (data source: Tab.System.HD)

heat distribution type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
D	decentral system	poor	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		medium	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	
		high	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	
	consideration in "common"		1	1	1	1		1		1	1	1	1		1		1	1	1	1	1	1	n=16	
C_Int	central heating, all pipes inside of thermal envelope	poor	30,0	0,0	12,0	6,5	7,0	6,3	0,0	6,2	0,0		6,2	12,5	20,1	32,1	6,5	0,0	12,0	1,5	0,0		20,5	+279%
		medium	20,0	0,0	12,0	4,1	7,0	4,2	0,0	6,2	0,0		3,3	8,4	5,6	6,4	6,5	0,0	12,0	1,5	0,0		5,4	
		high	10,0	0,0	12,0	1,7	7,0	1,1	0,0	6,2	0,0		0,5	3,7	0,0	0,5	6,5	0,0	12,0	1,5	0,0		1,7	-68%
	consideration in "common"		1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1		n=18	
C_Ext	central heating, fraction of pipeline outside of thermal envelope	poor	7,0	17,0		13,3	33,0	31,7	22,1	19,6	0,0		22,6	12,4		53,1	13,0	22,1	23,5	4,0			36,4	+237%
		medium	7,0	9,7		12,2	18,7	18,6	5,3	12,7	0,0		9,0	7,6		19,7	13,0	5,3	19,9	3,5			10,8	
		high	7,0	3,8		11,0	8,5	5,7	0,7	5,7	0,0		0,8	4,9		2,0	13,0	0,7	16,2	3,0			2,8	-74%
	consideration in "common"		1	1		1	1	1	1	1	1		1	1		1	1	1	1	1			n=15	

Remarks

10-04-2015

Determination of common values

C_Ext FR: not considered / 0 kWh/(m²a) is not plausible

Figure 19: **Annual distribution heat losses of heating systems /**

central heating: <C_Int> all pipes inside of thermal envelope; <C_Ext> fraction of pipeline outside of thermal envelope

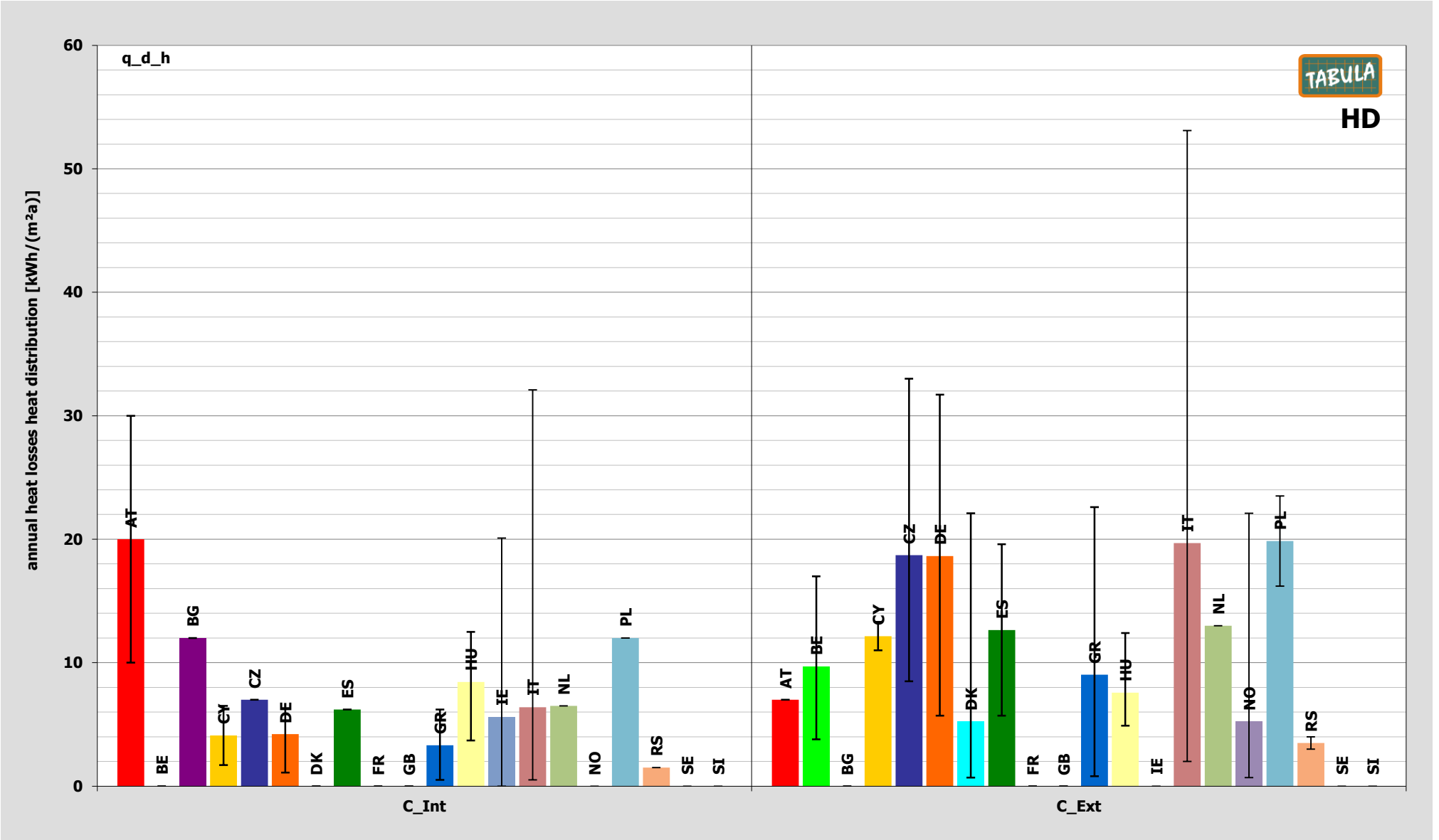

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Table 22: Annual heat loss of the space heating distribution / derived default values (simplified common values)

TABULA code	description	heat loss of the space heating distribution		
		annual heat losses during heating season per m² reference area		
		$q_{d,h}$		
		[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**
D	decentral system	0,0	0,0	0,0
C_Int	central heating, all pipes inside of thermal envelope	20,5	5,4	1,7
C_Ext	central heating, fraction of pipeline outside of thermal envelope	36,4	10,8	2,8

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4.5 HA – Heating Systems / Auxiliary Energy

Table 23: Annual auxiliary electricity demand of space heating systems differentiated by country and by building size class (data source: Tab.System.HA)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
D	SUH	min	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	-	-	-	0,0	0,0	0,0	0,0	-	0,0	0,0	-7%
		average	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	-	-	-	0,0	0,0	0,0	0,0	-	0,0	0,0	
		max	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	-	-	-	0,0	0,0	0,0	0,0	-	0,0	0,0	+87%
	MUH	min	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	3,0	-	1,6	0,0	0,0	0,0	0,0	-	0,0	0,3	-30%
		average	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	3,0	-	3,3	0,0	0,0	0,0	0,0	-	0,0	0,4	+5456 %
		max	0,0	0,0	0,0	0,0	-	0,0	-	0,0	0,0	0,1	0,0	3,0	-	4,9	0,0	0,0	0,0	0,0	-	0,0	0,8	+91%
	deviation from "common"		-100%	-100%	-100%	-100%		-100%		-100%	-100%	-50%	-100%				-100%	-100%	-100%	-100%		-100%		
C	SUH	min	6,7	1,1	5,5	1,1	0,5	6,1	3,2	-	0,2	1,3	0,0	2,0	0,6	2,7	2,2	3,8	6,2	1,0	1,6	2,7	2,4	-31%
		average	6,7	2,8	5,5	2,8	4,3	6,1	4,3	-	0,5	1,3	1,8	2,5	1,5	3,8	2,7	4,3	6,2	2,8	4,5	2,7	3,5	
		max	6,7	4,8	5,5	3,6	8,0	6,1	5,5	-	0,6	1,3	5,5	3,0	2,6	4,4	3,1	4,8	6,2	4,5	8,1	2,7	4,8	+35%
	MUH	min	2,0	1,1	3,0	1,1	0,5	1,8	5,5	1,8	0,2	1,3	0,0	0,3	1,8	1,6	2,2	5,5	6,2	1,0	5,3	2,7	2,1	-27%
		average	2,0	2,8	3,0	2,8	1,8	1,8	5,5	1,8	0,5	1,3	1,8	0,7	2,3	2,0	2,7	5,5	6,2	2,8	8,9	2,7	2,9	-17%
		max	2,0	4,8	3,0	3,6	3,0	1,8	5,5	1,8	0,6	1,3	5,5	1,7	3,0	2,6	3,1	5,5	6,2	4,5	12,0	2,7	4,1	+40%
	deviation from "common"		+35%	-14%	+32%	-14%	-7%	+22%	+52%		-85%	-60%	-45%	-50%	-41%	-10%	-16%	+52%	+92%	-14%	+107%	-16%		

Table 24: Deviations from averages ("common values") per country (data source: Tab.System.HA)

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
D	-100%	-100%	-100%	-100%		-100%		-100%	-100%	-50%	-100%				-100%	-100%	-100%	-100%		-100%
C	+35%	-14%	+32%	-14%	-7%	+22%	+52%		-85%	-60%	-45%	-50%	-41%	-10%	-16%	+52%	+92%	-14%	+107%	-16%

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Table 25: Annual auxiliary electricity demand of space heating systems /merged and condensed values

heating system type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
D	decentral system, no distribution ducts available	poor	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,1	0,0	3,0		4,9	0,0	0,0	0,0	0,0		0,0	2,7	+580%
		medium	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,1	0,0	3,0		3,3	0,0	0,0	0,0	0,0		0,0	0,4	
		high	0,0	0,0	0,0	0,0		0,0		0,0	0,0	0,1	0,0	3,0		1,6	0,0	0,0	0,0	0,0		0,0	0,1	-63%
	consideration in "common"		1	1	1	1		1		1	1	1	1	1		1	1	1	1	1		1	n=16	
C	central heating, distribution by pipeline	poor	6,7	4,8	5,5	3,6	8,0	6,1	5,5	1,8	0,6	1,3	5,5	3,0	3,0	4,4	3,1	5,5	6,2	4,5	12,0	2,7	8,3	+162%
		medium	4,4	2,8	4,3	2,8	3,0	4,0	4,9	1,8	0,5	1,3	1,8	1,6	1,9	2,9	2,7	4,9	6,2	2,8	6,7	2,7	3,2	
		high	2,0	1,1	3,0	1,1	0,5	1,8	3,2	1,8	0,2	1,3	0,0	0,3	0,6	1,6	2,2	3,8	6,2	1,0	1,6	2,7	0,9	-72%
	consideration in "common"		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	n=20	

Remarks 10-04-2015

Determination of common values

D IT: not considered (central heating system per apartment; here the category "D" would be interpreted as a system without pump)

C FR: not considered / 0 kWh/(m²a) is not plausible

Figure 20: **Annual auxiliary electricity demand of space heating systems /**
<C> central heating systems

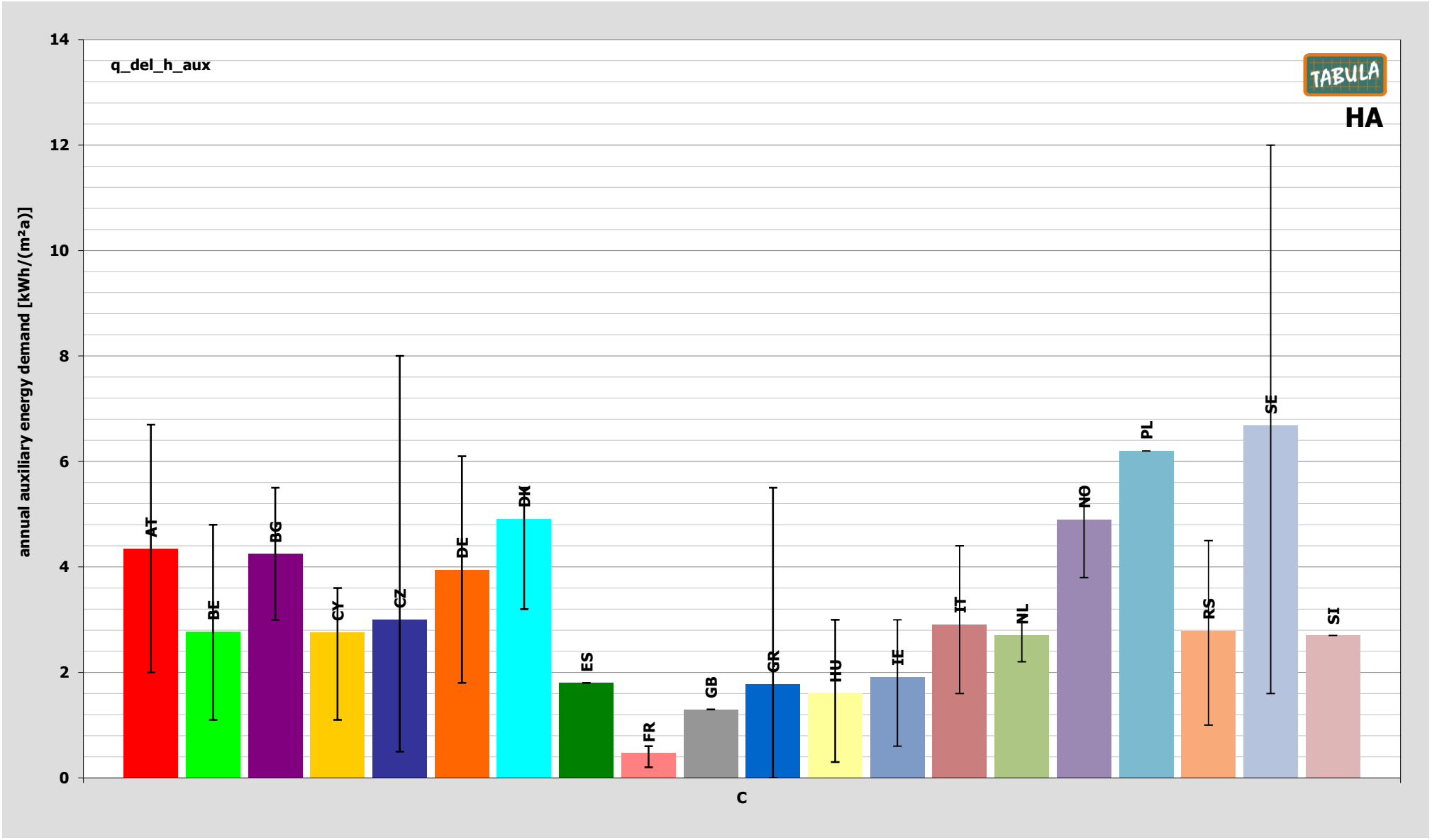

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Table 26: Annual auxiliary electricity demand of space heating systems / derived default values (simplified common values)

TABULA code	description	auxiliary energy demand (electricity) of heating systems		
		annual values in kWh per m² reference area for heat generation (blower, control), storage (pump), distribution (pump) and heat emission (fan), as far as available		
		$q_{del,h,aux}$		
		[kWh/(m²a)]		
energy efficiency		**poor**	**standard**	**high**
D	decentral system, no distribution ducts available	2,7	0,4	0,1
C	central heating, distribution by pipeline	8,3	3,2	0,9

10-04-2015

4.6 WG – Domestic Hot Water Systems / Heat Generation

Table 27: Energy expenditure factors heat generation (DHW systems) differentiated by country and by building size class (data source: Tab.System.WG)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
B	SUH	min	1,33	-	1,60	1,14	-	-	-	-	-	-	1,26	-	-	-	-	-	-	-	-	-	1,29	-16%
		average	1,53	-	1,60	1,62	-	-	-	-	-	-	1,39	-	-	-	-	-	-	-	-	-	1,53	
		max	1,67	-	1,60	2,30	-	-	-	-	-	-	1,64	-	-	-	-	-	-	-	-	-	1,90	+24%
	MUH	min	1,33	-	1,60	1,14	-	-	-	-	-	-	1,26	-	-	-	-	-	-	-	-	-	1,29	-16%
		average	1,53	-	1,60	1,62	-	-	-	-	-	-	1,39	-	-	-	-	-	-	-	-	-	1,53	+0%
		max	1,67	-	1,60	2,30	-	-	-	-	-	-	1,64	-	-	-	-	-	-	-	-	-	1,90	+24%
	deviation from "common"		-0%		+4%	+5%							-9%											
B_NC	SUH	min	1,25	1,31	1,12	-	-	-	1,07	1,11	-	-	1,53	-	-	1,24	-	1,11	-	1,51	1,51	-	1,26	-5%
		average	1,41	1,36	1,12	-	-	-	1,12	1,22	-	-	1,53	-	-	1,36	-	1,15	-	1,51	1,51	-	1,33	
		max	1,53	1,47	1,12	-	-	-	1,16	1,43	-	-	1,53	-	-	1,48	-	1,18	-	1,51	1,51	-	1,40	+6%
	MUH	min	1,25	1,28	1,12	-	-	-	-	1,11	-	-	1,53	-	-	1,17	-	1,11	-	1,51	1,51	-	1,27	-6%
		average	1,41	1,36	1,12	-	-	-	-	1,22	-	-	1,53	-	-	1,31	-	1,15	-	1,51	1,51	-	1,35	+1%
		max	1,53	1,44	1,12	-	-	-	-	1,43	-	-	1,53	-	-	1,53	-	1,18	-	1,51	1,51	-	1,43	+6%
	deviation from "common"		+6%	+2%	-16%					-9%			+14%			-0%		-14%		+13%	+13%			
B_NC_CT	SUH	min	1,30	1,85	-	1,12	1,47	1,63	1,07	-	1,63	-	1,07	1,71	1,25	-	1,25	-	1,54	-	-	1,71	1,41	-9%
		average	1,47	1,85	-	1,41	1,50	1,70	1,30	-	1,82	-	1,26	1,77	1,44	-	1,28	-	1,54	-	-	1,77	1,55	
		max	1,59	1,85	-	2,49	1,54	1,76	1,54	-	1,97	-	1,50	1,82	1,62	-	1,30	-	1,54	-	-	1,82	1,77	+15%
	MUH	min	1,30	1,48	-	1,12	1,47	1,32	1,14	-	1,86	-	1,07	1,30	1,40	-	1,25	-	1,54	-	-	1,30	1,33	-12%
		average	1,47	1,52	-	1,41	1,50	1,38	1,34	-	2,36	-	1,26	1,56	1,51	-	1,28	-	1,54	-	-	1,56	1,52	-2%
		max	1,59	1,56	-	2,49	1,54	1,43	1,54	-	3,14	-	1,50	1,82	1,62	-	1,30	-	1,54	-	-	1,82	1,86	+23%
	deviation from "common"		-4%	+10%		-8%	-2%	+1%	-14%		+37%		-18%	+9%	-4%		-17%		+1%			+9%		
B_NC_LT	SUH	min	1,14	-	-	1,14	1,33	1,27	-	-	1,65	-	1,09	-	-	1,20	-	-	1,16	1,22	1,22	-	1,23	-5%
		average	1,16	-	-	1,47	1,38	1,33	-	-	1,68	-	1,14	-	-	1,21	-	-	1,16	1,22	1,22	-	1,30	
		max	1,18	-	-	1,81	1,43	1,38	-	-	1,71	-	1,19	-	-	1,22	-	-	1,16	1,22	1,22	-	1,39	+7%
	MUH	min	1,14	-	-	1,14	1,33	1,20	-	-	1,65	-	1,09	-	-	-	-	-	1,11	1,22	1,22	-	1,22	-9%
		average	1,16	-	-	1,47	1,38	1,25	-	-	2,06	-	1,14	-	-	-	-	-	1,11	1,22	1,22	-	1,33	+3%
		max	1,18	-	-	1,81	1,43	1,29	-	-	2,45	-	1,19	-	-	-	-	-	1,11	1,22	1,22	-	1,54	+15%
	deviation from "common"		-12%			+11%	+5%	-2%			+42%		-13%						-14%	-7%	-7%			
B_C	SUH	min	1,03	1,17	1,06	1,25	1,02	1,21	1,02	1,00	1,22	1,19	1,02	1,19	1,11	1,12	1,11	1,05	1,10	1,07	1,07	1,19	1,10	-4%
		average	1,04	1,17	1,06	1,33	1,20	1,26	1,04	1,00	1,38	1,32	1,10	1,20	1,11	1,12	1,11	1,05	1,10	1,07	1,07	1,20	1,15	
		max	1,06	1,17	1,06	1,40	1,32	1,31	1,05	1,00	1,61	1,45	1,15	1,20	1,11	1,12	1,11	1,05	1,10	1,07	1,07	1,20	1,20	+5%
	MUH	min	1,03	-	1,06	1,25	1,02	1,17	1,05	1,00	1,22	1,19	1,02	1,10	1,11	1,12	1,11	1,05	1,10	1,07	1,07	1,10	1,09	-6%
		average	1,04	-	1,06	1,33	1,20	1,20	1,05	1,00	1,81	1,32	1,10	1,11	1,11	1,12	1,11	1,05	1,13	1,07	1,07	1,11	1,16	+1%
		max	1,06	-	1,06	1,40	1,32	1,24	1,05	1,00	2,35	1,45	1,15	1,13	1,11	1,12	1,11	1,05	1,15	1,07	1,07	1,13	1,27	+10%
	deviation from "common"		-9%		-8%	+15%	+4%	+7%	-9%	-13%	+39%	+15%	-4%	+0%	-4%	-3%	-4%	-9%	-3%	-7%	-7%	+0%		
B_WP	SUH	min	1,34	-	1,34	-	1,33	1,63	-	1,05	1,33	-	-	-	-	1,42	-	1,18	-	1,18	1,18	-	1,28	-3%
		average	1,34	-	1,34	-	1,33	1,63	-	1,05	1,33	-	-	-	-	1,56	-	1,18	-	1,18	1,18	-	1,31	
		max	1,34	-	1,34	-	1,33	1,63	-	1,05	1,33	-	-	-	-	1,69	-	1,18	-	1,18	1,18	-	1,36	+4%
	MUH	min	1,34	-	1,34	-	1,33	1,32	-	-	1,72	-	-	-	-	-	-	1,18	-	1,18	1,18	-	1,31	-1%
		average	1,34	-	1,34	-	1,33	1,32	-	-	1,72	-	-	-	-	-	-	1,18	-	1,18	1,18	-	1,32	+1%
		max	1,34	-	1,34	-	1,33	1,32	-	-	1,72	-	-	-	-	-	-	1,18	-	1,18	1,18	-	1,37	+3%
	deviation from		+2%		+2%		+1%	+12%			+16%							-10%		-10%	-10%			

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
	"common"																							
G_IWH	SUH	min	1,13	-	1,13	1,34	-	1,31	-	-	2,17	-	1,27	-	-	-	-	-	1,82	-	-	-	1,41	-5%
		average	1,14	-	1,13	1,34	-	1,33	-	-	2,38	-	1,27	-	-	-	-	-	1,82	-	-	-	1,49	
		max	1,15	-	1,13	1,34	-	1,35	-	-	2,62	-	1,27	-	-	-	-	-	1,82	-	-	-	1,66	+12%
	MUH	min	1,13	-	1,13	1,34	-	1,31	-	-	2,17	-	1,27	-	-	-	-	-	1,82	-	-	-	1,41	-5%
		average	1,14	-	1,13	1,34	-	1,33	-	-	2,38	-	1,27	-	-	-	-	-	1,82	-	-	-	1,49	0%
		max	1,15	-	1,13	1,34	-	1,35	-	-	2,62	-	1,27	-	-	-	-	-	1,82	-	-	-	1,66	+12%
	deviation from "common"		-23%		-24%	-10%		-11%			+60%		-15%						+22%					
G_IWH_NC	SUH	min	-	1,31	-	-	1,31	1,31	-	1,11	1,65	-	1,25	-	-	1,39	1,30	-	1,19	-	-	-	1,29	-6%
		average	-	1,31	-	-	1,33	1,33	-	1,17	1,68	-	1,25	-	-	1,77	1,30	-	1,19	-	-	-	1,37	
		max	-	1,31	-	-	1,35	1,35	-	1,23	1,71	-	1,25	-	-	2,47	1,30	-	1,19	-	-	-	1,56	+14%
	MUH	min	-	1,31	-	-	1,31	1,31	-	1,11	1,65	-	1,25	-	-	1,39	1,30	-	1,19	-	-	-	1,29	-6%
		average	-	1,31	-	-	1,33	1,33	-	1,17	1,68	-	1,25	-	-	1,77	1,30	-	1,19	-	-	-	1,37	0%
		max	-	1,31	-	-	1,35	1,35	-	1,23	1,71	-	1,25	-	-	2,47	1,30	-	1,19	-	-	-	1,56	+14%
	deviation from "common"			-4%			-3%	-3%		-15%	+23%		-9%			+29%	-5%		-13%					
G_IWH_C	SUH	min	-	-	-	-	-	1,27	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,27	-3%
		average	-	-	-	-	-	1,29	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,32	
		max	-	-	-	-	-	1,31	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,38	+5%
	MUH	min	-	-	-	-	-	1,27	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,27	-3%
		average	-	-	-	-	-	1,29	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,32	0%
		max	-	-	-	-	-	1,31	-	-	1,61	-	1,12	-	-	1,24	-	-	-	-	-	-	1,38	+5%
	deviation from "common"							-2%			+22%		-15%			-6%								
G_Tank	SUH	min	-	-	-	-	1,34	1,34	-	-	-	-	1,22	1,22	-	-	-	-	-	-	-	1,22	1,26	-1%
		average	-	-	-	-	1,34	1,34	-	-	-	-	1,22	1,22	-	-	-	-	-	-	-	1,22	1,27	
		max	-	-	-	-	1,34	1,34	-	-	-	-	1,22	1,22	-	-	-	-	-	-	-	1,22	1,28	+1%
	MUH	min	-	-	-	-	1,34	1,34	-	-	5,78	-	1,22	-	-	-	-	-	-	-	-	-	2,18	-10%
		average	-	-	-	-	1,34	1,34	-	-	5,78	-	1,22	-	-	-	-	-	-	-	-	-	2,42	+91%
		max	-	-	-	-	1,34	1,34	-	-	5,78	-	1,22	-	-	-	-	-	-	-	-	-	3,09	+28%
	deviation from "common"						-27%	-27%					-34%											
E	SUH	min	1,01	1,00	-	-	-	-	1,00	-	-	-	1,03	-	-	1,33	-	-	-	1,05	1,05	-	1,06	-1%
		average	1,01	1,00	-	-	-	-	1,00	-	-	-	1,04	-	-	1,33	-	-	-	1,05	1,05	-	1,07	
		max	1,01	1,00	-	-	-	-	1,00	-	-	-	1,05	-	-	1,33	-	-	-	1,05	1,05	-	1,10	+3%
	MUH	min	1,01	1,00	-	-	-	-	-	-	-	-	1,03	-	-	1,33	-	-	-	1,05	1,05	-	1,07	-1%
		average	1,01	1,00	-	-	-	-	-	-	-	-	1,04	-	-	1,33	-	-	-	1,05	1,05	-	1,08	+1%
		max	1,01	1,00	-	-	-	-	-	-	-	-	1,05	-	-	1,33	-	-	-	1,05	1,05	-	1,12	+3%
	deviation from "common"		-6%	-7%									-3%			+24%				-2%	-2%			
E_Immersion	SUH	min	-	-	1,00	1,03	-	1,00	-	1,00	1,11	1,00	1,00	-	1,00	-	-	1,02	1,00	1,05	1,05	-	1,02	-3%
		average	-	-	1,00	1,28	-	1,00	-	1,00	1,18	1,00	1,06	-	1,00	-	-	1,02	1,00	1,05	1,05	-	1,05	
		max	-	-	1,00	1,52	-	1,00	-	1,00	1,25	1,00	1,11	-	1,00	-	-	1,02	1,00	1,05	1,05	-	1,12	+6%
	MUH	min	-	-	1,00	1,03	-	1,00	-	1,00	1,11	1,00	1,00	-	1,00	-	-	1,02	-	1,05	1,05	-	1,02	-3%
		average	-	-	1,00	1,28	-	1,00	-	1,00	1,11	1,00	1,06	-	1,00	-	-	1,02	-	1,05	1,05	-	1,05	-0%
		max	-	-	1,00	1,52	-	1,00	-	1,00	1,11	1,00	1,11	-	1,00	-	-	1,02	-	1,05	1,05	-	1,12	+6%
	deviation from "common"				-5%	+21%		-5%		-5%	+9%	-5%	+0%		-5%			-3%		-0%	-0%			
E_IWH	SUH	min	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	-	-	-	-	1,00	0%
		average	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	-	-	-	-	1,00	
		max	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	-	-	-	-	1,00	0%
	MUH	min	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	1,00	-	-	-	1,00	0%
		average	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	1,00	-	-	-	1,00	0%
		max	-	-	1,00	-	1,00	1,00	-	-	-	-	1,00	-	-	-	-	-	1,00	-	-	-	1,00	0%

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
	deviation from "common"				0%		0%	0%					0%											
HP	SUH	min	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,44	-5%
		average	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,46	
		max	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,49	+8%
	MUH	min	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,44	-5%
		average	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,46	0%
		max	-	0,37	-	0,60	-	-	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	0,49	+8%
	deviation from "common"			-19%		+31%							-12%											
HP_Air	SUH	min	-	-	-	-	0,35	0,35	-	-	0,43	-	0,29	-	0,26	0,35	-	0,49	-	0,33	0,33	-	0,34	-13%
		average	-	-	-	-	0,39	0,40	-	-	0,64	-	0,30	-	0,31	0,37	-	0,49	-	0,33	0,33	-	0,39	
		max	-	-	-	-	0,42	0,45	-	-	0,84	-	0,33	-	0,36	0,41	-	0,49	-	0,33	0,33	-	0,48	+22%
	MUH	min	-	-	-	-	0,35	0,35	-	-	0,84	-	0,29	-	0,26	0,35	-	0,49	-	0,33	0,33	-	0,39	-7%
		average	-	-	-	-	0,39	0,40	-	-	0,84	-	0,30	-	0,26	0,38	-	0,49	-	0,33	0,33	-	0,41	+5%
		max	-	-	-	-	0,42	0,45	-	-	0,84	-	0,33	-	0,26	0,39	-	0,49	-	0,33	0,33	-	0,47	+13%
	deviation from "common"						-5%	-1%			+83%		-25%		-29%	-8%		+21%		-18%	-18%			
HP_Ground	SUH	min	-	-	0,25	-	0,25	0,29	-	-	0,47	-	0,22	-	0,38	0,29	-	0,43	0,25	0,25	0,25	-	0,30	-4%
		average	-	-	0,25	-	0,29	0,32	-	-	0,47	-	0,22	-	0,38	0,29	-	0,43	0,25	0,25	0,25	-	0,31	
		max	-	-	0,25	-	0,32	0,36	-	-	0,47	-	0,22	-	0,38	0,29	-	0,43	0,25	0,25	0,25	-	0,33	+6%
	MUH	min	-	-	0,25	-	0,25	0,29	-	-	-	-	0,22	-	-	0,29	-	0,43	-	0,25	0,25	-	0,27	-5%
		average	-	-	0,25	-	0,29	0,32	-	-	-	-	0,22	-	-	0,29	-	0,43	-	0,25	0,25	-	0,29	-7%
		max	-	-	0,25	-	0,32	0,36	-	-	-	-	0,22	-	-	0,29	-	0,43	-	0,25	0,25	-	0,31	+8%
	deviation from "common"				-16%		-4%	+8%					-26%			-3%		+44%		-16%	-16%			
HP_ExhAir	SUH	min	-	-	-	-	0,30	0,30	-	-	0,63	-	0,29	-	-	-	-	-	-	-	-	-	0,36	-9%
		average	-	-	-	-	0,30	0,30	-	-	0,71	-	0,29	-	-	-	-	-	-	-	-	-	0,40	
		max	-	-	-	-	0,30	0,30	-	-	0,78	-	0,29	-	-	-	-	-	-	-	-	-	0,49	+23%
	MUH	min	-	-	-	-	0,30	0,30	-	-	0,63	-	0,29	-	-	-	-	-	-	-	-	-	0,36	-9%
		average	-	-	-	-	0,30	0,30	-	-	0,71	-	0,29	-	-	-	-	-	-	-	-	-	0,40	0%
		max	-	-	-	-	0,30	0,30	-	-	0,78	-	0,29	-	-	-	-	-	-	-	-	-	0,49	+23%
	deviation from "common"						-25%	-25%			+77%		-27%											
HP_Water	SUH	min	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	0%
		average	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	
		max	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	0%
	MUH	min	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	0%
		average	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	0%
		max	-	-	0,25	-	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	0,25	0%
	deviation from "common"				0%								0%											
HP_Cellar	SUH	min	-	-	-	-	-	0,35	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,32	-5%
		average	-	-	-	-	-	0,37	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,34	
		max	-	-	-	-	-	0,39	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,36	+7%
	MUH	min	-	-	-	-	-	0,35	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,32	-5%
		average	-	-	-	-	-	0,37	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,34	0%
		max	-	-	-	-	-	0,39	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	0,36	+7%
	deviation from "common"							+10%					-10%											
HP_Other	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	MUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	deviation from "common"																							
TS	SUH	min	1,02	-	-	-	1,02	1,14	1,03	-	-	-	1,05	-	-	-	-	1,02	1,15	1,24	1,24	-	1,09	-2%
		average	1,02	-	-	-	1,04	1,14	1,05	-	-	-	1,15	-	-	-	-	1,02	1,15	1,24	1,24	-	1,12	
		max	1,02	-	-	-	1,05	1,14	1,06	-	-	-	1,25	-	-	-	-	1,02	1,15	1,24	1,24	-	1,14	+2%
	MUH	min	1,02	-	1,03	-	1,02	1,14	1,03	-	1,56	-	1,05	1,14	-	-	-	1,02	1,15	1,24	1,24	1,14	1,13	-11%
		average	1,02	-	1,05	-	1,04	1,14	1,05	-	3,13	-	1,15	1,14	-	-	-	1,02	1,15	1,24	1,24	1,14	1,27	+14%
		max	1,02	-	1,07	-	1,05	1,14	1,06	-	5,10	-	1,25	1,14	-	-	-	1,02	1,15	1,24	1,24	1,14	1,69	+34%
	deviation from "common"		-14%				-13%	-4%	-12%				-4%					-14%	-4%	+4%	+4%			
CHP	SUH	min	-	-	-	1,67	-	1,48	-	-	-	-	1,18	-	-	-	-	-	1,27	-	-	-	1,36	-6%
		average	-	-	-	1,67	-	1,58	-	-	-	-	1,24	-	-	-	-	-	1,27	-	-	-	1,44	
		max	-	-	-	1,67	-	1,67	-	-	-	-	1,30	-	-	-	-	-	1,27	-	-	-	1,52	+5%
	MUH	min	-	-	-	1,67	-	1,48	-	-	-	-	1,18	-	-	-	-	-	1,27	-	-	-	1,36	-6%
		average	-	-	-	1,67	-	1,58	-	-	-	-	1,24	-	-	-	-	-	1,27	-	-	-	1,44	0%
		max	-	-	-	1,67	-	1,67	-	-	-	-	1,30	-	-	-	-	-	1,27	-	-	-	1,52	+5%
	deviation from "common"					+16%		+9%					-14%						-12%					
Solar	SUH	min	0,00	0,15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,01	-56%
		average	0,00	0,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,02	
		max	0,00	0,47	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,05	+176%
	MUH	min	0,00	0,15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,01	-56%
		average	0,00	0,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,02	0%
		max	0,00	0,47	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	0,00	0,00	0,00	0,00	0,00	0,05	+176%
	deviation from "common"		-100%	+1800%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%		-100%	-100%	-100%	-100%	-100%		
Steam	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	MUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	deviation from "common"																							
Other	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	MUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	deviation from "common"																							

Table 28: Deviations from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
B	-0%		+4%	+5%							-9%									
B_NC	+6%	+2%	-16%					-9%			+14%			-0%		-14%		+13%	+13%	
B_NC_CT	-4%	+10%		-8%	-2%	+1%	-14%		+37%		-18%	+9%	-4%		-17%		+1%			+9%
B_NC_LT	-12%			+11%	+5%	-2%			+42%		-13%						-14%	-7%	-7%	
B_C	-9%		-8%	+15%	+4%	+7%	-9%	-13%	+39%	+15%	-4%	+0%	-4%	-3%	-4%	-9%	-3%	-7%	-7%	+0%
B_WP	+2%		+2%		+1%	+12%			+16%							-10%		-10%	-10%	
G_IWH	-23%		-24%	-10%		-11%			+60%		-15%						+22%			
G_IWH_NC		-4%			-3%	-3%		-15%	+23%		-9%			+29%	-5%		-13%			
G_IWH_C						-2%			+22%		-15%			-6%						
G_Tank					-27%	-27%					-34%									
E	-6%	-7%									-3%			+24%				-2%	-2%	
E_Immersion			-5%	+21%		-5%		-5%	+9%	-5%	+0%		-5%			-3%		-0%	-0%	
E_IWH			0%		0%	0%					0%									
HP		-19%		+31%							-12%									
HP_Air					-5%	-1%			+83%		-25%		-29%	-8%		+21%		-18%	-18%	
HP_Ground			-16%		-4%	+8%					-26%			-3%		+44%		-16%	-16%	
HP_ExhAir					-25%	-25%			+77%		-27%									
HP_Water			0%								0%									
HP_Cellar						+10%					-10%									
HP_Other																				
TS	-14%				-13%	-4%	-12%				-4%					-14%	-4%	+4%	+4%	
CHP				+16%		+9%					-14%						-12%			
Solar	-100%	+1800%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%		-100%	-100%	-100%	-100%	-100%

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Table 29: Energy expenditure factors heat generation (dhw systems) / merged and condensed values (data source: Tab.System.WG)

heat generator type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
B_NC	boiler, non-condensing	poor	1,59	1,85	1,12	2,49	1,54	1,76	1,54	1,43	3,14		1,53	1,82	1,62	1,53	1,30	1,18	1,54	1,51	1,51	1,82	2,41	+72%
		medium	1,35	1,52	1,12	1,44	1,44	1,42	1,25	1,22	1,98		1,31	1,66	1,48	1,29	1,28	1,15	1,34	1,37	1,37	1,66	1,40	
		high	1,14	1,28	1,12	1,12	1,33	1,20	1,07	1,11	1,63		1,07	1,30	1,25	1,17	1,25	1,11	1,11	1,22	1,22	1,30	1,14	-19%
	consideration in "common"		1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	n=19	
B_C	boiler, condensing	poor	1,06	1,17	1,06	1,40	1,32	1,31	1,05	1,00	2,35	1,45	1,15	1,20	1,11	1,12	1,11	1,05	1,15	1,07	1,07	1,20	1,79	+55%
		medium	1,04	1,17	1,06	1,33	1,20	1,23	1,04	1,00	1,60	1,32	1,10	1,15	1,11	1,12	1,11	1,05	1,11	1,07	1,07	1,15	1,15	
		high	1,03	1,17	1,06	1,25	1,02	1,17	1,02	1,00	1,22	1,19	1,02	1,10	1,11	1,12	1,11	1,05	1,10	1,07	1,07	1,10	1,05	-9%
	consideration in "common"		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	n=20	
B_WP	wood-pellets boiler	poor	1,34		1,34		1,33	1,63		1,05	1,72					1,69		1,18		1,18	1,18		1,54	+17%
		medium	1,34		1,34		1,33	1,48		1,05	1,53					1,56		1,18		1,18	1,18		1,32	
		high	1,34		1,34		1,33	1,32		1,05	1,33					1,42		1,18		1,18	1,18		1,16	-12%
	consideration in "common"		1		1		1	1		1	1					1		1		1	1		n=10	
G_IWH_NC	gas-fired instantaneous water heater, non-condensing	poor		1,31			1,35	1,35		1,23	1,71		1,25			2,47	1,30		1,19				1,97	+44%
		medium		1,31			1,33	1,33		1,17	1,68		1,25			1,77	1,30		1,19				1,37	
		high		1,31			1,31	1,31		1,11	1,65		1,25			1,39	1,30		1,19				1,21	-12%
	consideration in "common"			1			1	1		1	1		1			1	1		1				n=9	
G_IWH_C	gas-fired instantaneous water heater, condensing	poor						1,31			1,61		1,12			1,24							1,47	+11%
		medium						1,29			1,61		1,12			1,24							1,32	
		high						1,27			1,61		1,12			1,24							1,22	-8%
	consideration in "common"							1			1		1			1							n=4	
G_Tank	gas burner for	poor						1,34	1,34		5,78		1,22	1,22								1,22	3,90	+93%

heat generator type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
	directly heated DHW tank	medium					1,34	1,34			5,78		1,22	1,22								1,22	2,02	
		high					1,34	1,34			5,78		1,22	1,22								1,22	1,62	-20%
	consideration in "common"						1	1			1		1	1								1	n=6	
E_Immersion	electric immersion heater	poor			1,00	1,52		1,00		1,00	1,25	1,00	1,11		1,00			1,02	1,00	1,05	1,05		1,30	+24%
		medium			1,00	1,28		1,00		1,00	1,15	1,00	1,06		1,00			1,02	1,00	1,05	1,05		1,05	
		high			1,00	1,03		1,00		1,00	1,11	1,00	1,00		1,00			1,02	1,00	1,05	1,05		1,01	-4%
	consideration in "common"				1	1		1		1	1	1	1		1			1	1	1	1		n=12	
E	direct electric heat generator, not specified	poor	1,01	1,00	1,00		1,00	1,00	1,00				1,05			1,33			1,00	1,05	1,05		1,19	+14%
		medium	1,01	1,00	1,00		1,00	1,00	1,00				1,02			1,33			1,00	1,05	1,05		1,04	
		high	1,01	1,00	1,00		1,00	1,00	1,00				1,00			1,33			1,00	1,05	1,05		1,02	-2%
	consideration in "common"		1	1	1		1	1	1				1			1			1	1	1		n=11	
HP_Air	heat pump, heat source external air	poor					0,42	0,45			0,84		0,33		0,36	0,41		0,49		0,33	0,33		0,64	+59%
		medium					0,39	0,40			0,74		0,30		0,29	0,37		0,49		0,33	0,33		0,40	
		high					0,35	0,35			0,43		0,29		0,26	0,35		0,49		0,33	0,33		0,31	-24%
	consideration in "common"						1	1			1		1		1	1		1		1	1		n=9	
HP_Ground	heat pump, heat source ground	poor			0,25		0,32	0,36			0,47		0,22		0,38	0,29		0,43	0,25	0,25	0,25		0,39	+27%
		medium			0,25		0,29	0,32			0,47		0,22		0,38	0,29		0,43	0,25	0,25	0,25		0,31	
		high			0,25		0,25	0,29			0,47		0,22		0,38	0,29		0,43	0,25	0,25	0,25		0,26	-15%
	consideration in "common"				1		1	1			1		1		1	1		1	1	1	1		n=11	
HP_ExhAir	heat pump, heat source exhaust air	poor					0,30	0,30			0,78		0,29										0,60	+50%
		medium					0,30	0,30			0,71		0,29										0,40	
		high					0,30	0,30			0,63		0,29										0,34	-16%
	consideration in "common"						1	1			1		1										n=4	
HP_Cellar	heat pump, heat source: cellar air	poor						0,39					0,30										0,37	+10%
		medium						0,37					0,30										0,34	
		high						0,35					0,30										0,31	-7%
	consideration in "common"							1					1										n=2	
TS	district heating transfer station	poor	1,02		1,07		1,05	1,14	1,06		5,10		1,25	1,14				1,02	1,15	1,24	1,24	1,14	3,27	+157%
		medium	1,02		1,05		1,04	1,14	1,05		3,13		1,15	1,14				1,02	1,15	1,24	1,24	1,14	1,27	
		high	1,02		1,03		1,02	1,14	1,03		1,56		1,05	1,14				1,02	1,15	1,24	1,24	1,14	1,08	-15%
	consideration in "common"		1		1		1	1	1		1		1	1				1	1	1	1	1	n=13	
CHP	combined heat and power generation	poor				1,67		1,67					1,30						1,27				1,57	+9%
		medium				1,67		1,58					1,24						1,27				1,44	
		high				1,67		1,48					1,18						1,27				1,29	-10%
	consideration in "common"					1		1					1						1				n=4	
Solar	thermal solar plant	poor	0,00	0,47	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,25	+1354%
		medium	0,00	0,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,02	
		high	0,00	0,15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	-77%
	consideration in "common"		1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	n=19	

Electricity generation expenditure factor

CHP	combined heat and power generation	poor	-	-		3,33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,33	0%
		medium	-	-		3,33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,33	
		high	-	-		3,33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,33	0%
	consideration in "common"					1																	n=1	

Remarks

10-04-2015

Merging of subdivisions of heat generators

B_NC: includes values of: B_NC, B_NC_CT, B_NC_LT

E: includes values of: E, E_IWH

Determination of common values

B_C: SI: not considered / values are unrealistic low (referring to Hi instead of HS?)

B_WP FR: not considered / values are unrealistic high

Solar: BE: not considered (indicated as solar system combined with boiler, this is not the idea of the heat generator "thermal solar plant")

Figure 21: **Heat generation expenditure factors of DHW systems /**
boilers: <B_NC> non-condensing, <B_C> condensing, <B_WP> wood-pellets

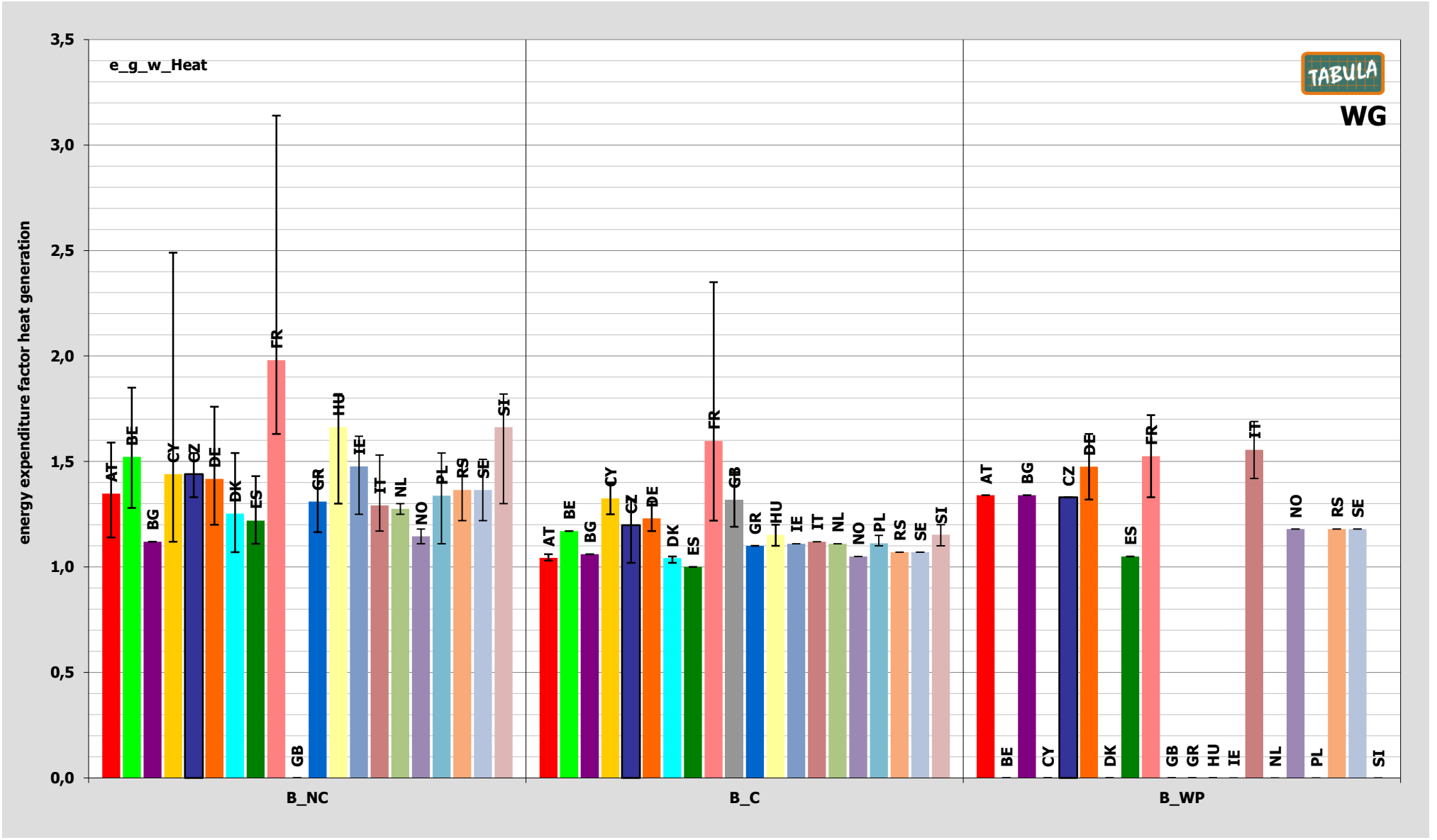

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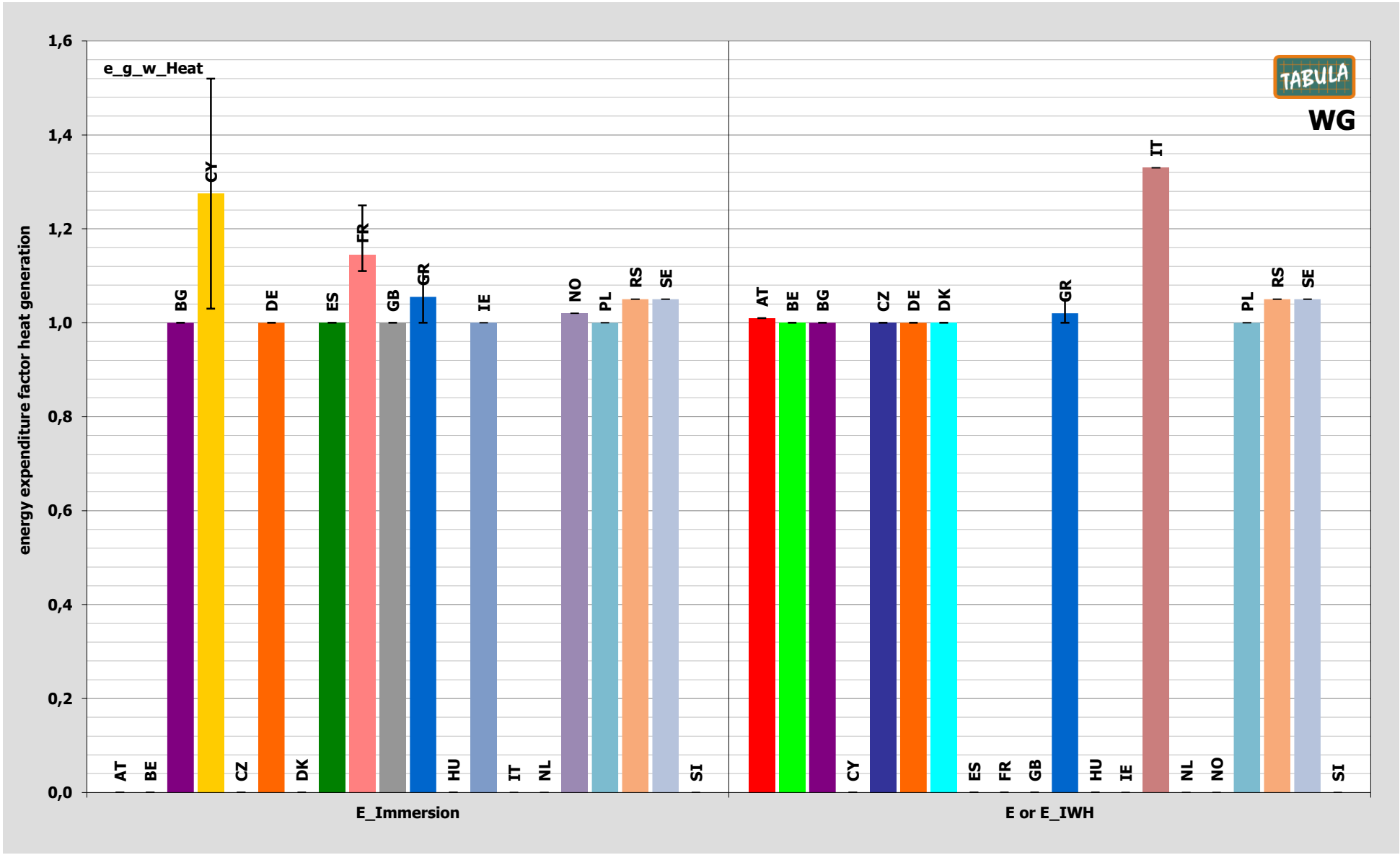
Figure 22: **Heat generation expenditure factors of DHW systems /**

<E_Immersion> electric immersion heaters, <E> or <E_IWH> electric instantaneous water heaters, electrical heat pumps, heat sources: <HP_Air> external air, <HP_Ground> ground, <HP_ExhAir> exhaust air, <HP_Cellar> cellar air



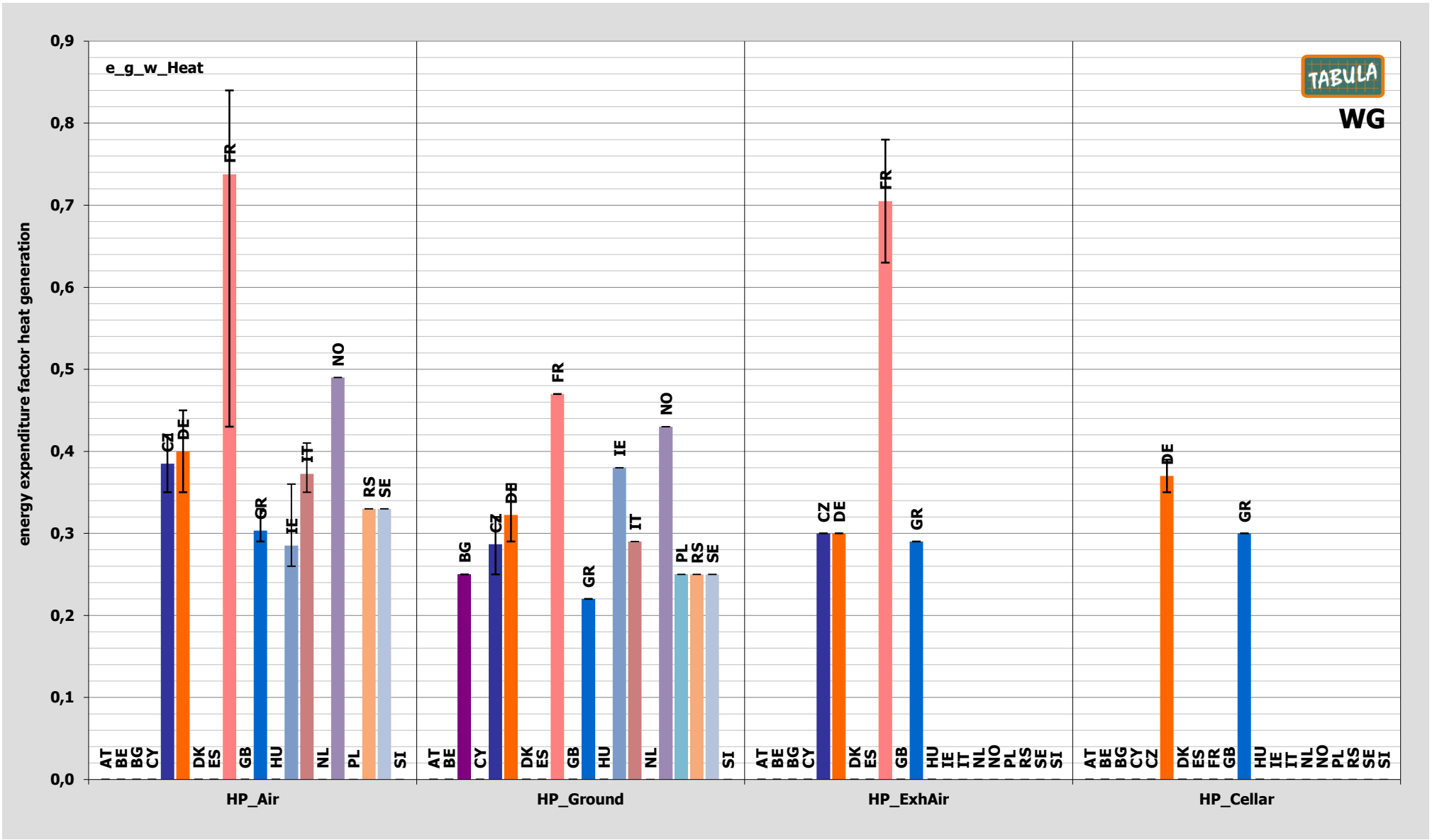

e_g_w_Heat
TABULA
WG
energy expenditure factor heat generation
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
HP_Air
HP_Ground
HP_ExhAir
HP_Cellar
AT BE BG CY CZ DE DK ES FR GB GR HU IE IT NL NO PL RS SE SI

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Figure 23: **Heat generation expenditure factors of DHW systems /**

gas-fired instantaneous water heaters: <G_IWH_NC> non-condensing, <G_IWH_C> condensing; <G_Tank> gas burner for directly heated DHW tank (not including storage losses), <TS> district heating transfer station

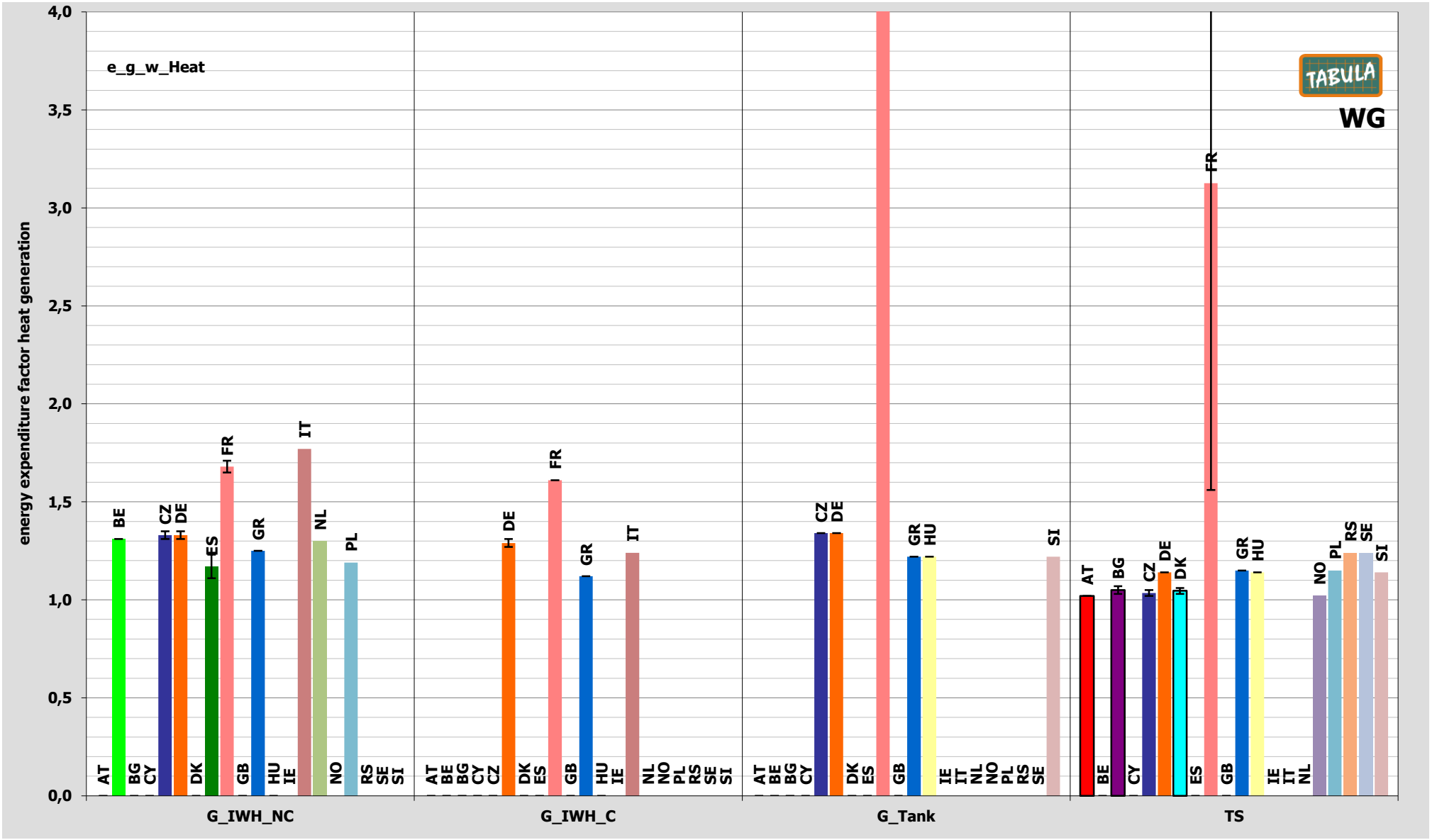

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Table 30: Heat generation of dhw systems / derived default values (simplified common values)

TABULA code	description	heat generation expenditure factor (dhw systems)			electricity generation expenditure factor (dhwsystems)		
		delivered energy demand (H_S) devided by produced heat			electricity demand devided by produced heat		
		$e_{g,w}$			$e_{g,el,w}$		
		[-]			[-]		
	energy efficiency	**poor**	**standard**	**high**	**poor**	**standard**	**high**
B_NC	boiler, non-condensing	2,41	1,40	1,14	-	-	-
B_C	boiler, condensing	1,79	1,15	1,05	-	-	-
B_WP	wood-pellets boiler	1,54	1,32	1,16	-	-	-
G_IWH_NC	gas-fired instantaneous water heater, non-condensing	1,97	1,37	1,21	-	-	-
G_IWH_C	gas-fired instantaneous water heater, condensing	1,47	1,32	1,22	-	-	-
G_Tank	gas burner for directly heated DHW tank	3,90	2,02	1,62	-	-	-
E_Immersion	electric immersion heater	1,30	1,05	1,01	-	-	-
E	direct electric heat generator, not specified	1,19	1,04	1,02	-	-	-
HP_Air	heat pump, heat source external air	0,64	0,40	0,31	-	-	-
HP_Ground	heat pump, heat source ground	0,39	0,31	0,26	-	-	-
HP_ExhAir	heat pump, heat source exhaust air	0,60	0,40	0,34	-	-	-
HP_Cellar	heat pump, heat source: cellar air	0,37	0,34	0,31	-	-	-
TS	district heating transfer station	3,27	1,27	1,08	-	-	-
CHP	combined heat and power generation	1,57	1,44	1,29	3,33	3,33	3,33
Solar	thermal solar plant	0,25	0,02	0,00	-	-	-

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4.7 WS – DHW Systems / Heat Storage

Table 31: Annual heat loss of the dhw heat storage differentiated by country and by building size class (data source: Tab.System.WS)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
S_D	SUH	min	4,3	-	3,0	3,1	3,9	2,9	-	7,3	-	-	2,4	-	-	-	-	1,2	3,0	-	0,2	0,0	2,6	-27%
		average	5,7	-	4,5	4,1	5,0	3,3	-	8,8	-	-	2,6	-	-	-	-	2,0	3,0	-	0,2	0,2	3,6	
		max	9,2	-	6,0	5,0	6,0	3,6	-	10,2	-	-	2,8	-	-	-	-	3,3	3,0	-	0,2	0,2	5,0	+40%
	MUH	min	4,3	-	3,0	3,1	3,9	2,9	-	7,3	-	-	2,4	-	-	-	-	1,2	3,0	-	0,2	0,2	2,6	-26%
		average	5,7	-	4,5	4,1	5,0	3,3	-	8,8	-	-	2,6	-	-	-	-	2,0	3,0	-	0,2	0,2	3,6	0%
		max	9,2	-	6,0	5,0	6,0	3,6	-	10,2	-	-	2,8	-	-	-	-	3,3	3,0	-	0,2	0,2	5,0	+40%
	deviation from "common"		+60%		+26%	+14%	+39%	-9%		+146%			-27%					-45%	-16%		-94%	-94%		
S_A	SUH	min	-	-	-	3,1	-	-	-	4,6	-	-	-	6,4	-	-	-	-	-	-	-	0,0	2,82	-42%
		average	-	-	-	3,1	-	-	-	4,6	-	-	-	6,8	-	-	-	-	-	-	-	-	4,84	
		max	-	-	-	3,1	-	-	-	4,6	-	-	-	7,2	-	-	-	-	-	-	-	-	5,53	+14%
	MUH	min	-	-	-	3,1	-	-	-	4,6	-	-	2,4	7,2	-	2,5	-	-	-	-	-	-	3,71	-15%
		average	-	-	-	3,1	-	-	-	4,6	-	-	2,4	7,2	-	4,5	-	-	-	-	-	-	4,37	-10%
		max	-	-	-	3,1	-	-	-	4,6	-	-	2,4	7,2	-	7,4	-	-	-	-	-	-	5,36	+22%
	deviation from "common"					-33%				+1%				+52%										
S_C_Int	SUH	min	3,4	1,6	-	5,8	6,5	5,6	2,9	2,4	0,0	5,7	2,0	6,4	1,5	2,8	2,9	6,3	3,0	2,5	0,5	0,0	3,09	-49%
		average	18,7	2,4	-	5,8	9,3	8,1	4,0	2,4	4,7	5,7	2,0	6,8	8,9	5,1	4,0	8,4	3,0	13,7	0,5	0,5	6,00	
		max	46,7	3,5	-	5,8	12,0	10,5	4,7	2,4	13,0	5,7	2,0	7,2	45,1	8,4	4,7	10,6	3,0	28,8	0,5	0,5	13,09	+118%
	MUH	min	3,4	1,6	-	5,8	1,1	1,0	2,6	2,4	0,0	5,7	2,0	1,2	3,3	1,6	2,6	1,3	3,0	0,1	0,5	0,5	1,98	-43%
		average	18,7	2,4	-	5,8	1,7	1,4	2,6	2,4	3,2	5,7	2,0	1,2	7,1	3,0	2,6	1,9	3,0	1,1	0,5	0,5	3,50	-42%
		max	46,7	3,5	-	5,8	2,2	1,8	2,6	2,4	13,0	5,7	2,0	1,2	14,6	4,9	2,6	2,4	3,0	2,0	0,5	0,5	8,20	+134%
	deviation from "common"		+294%	-50%		+22%	+15%	-1%	-31%	-49%	-17%	+20%	-58%	-16%	+68%	-14%	-31%	+8%	-37%	+55%	-89%	-89%		
S_C_Ext	SUH	min	-	1,9	-	-	6,5	5,6	-	2,4	4,2	-	-	-	-	3,6	-	12,0	4,0	-	0,5	0,0	3,70	-31%
		average	-	2,8	-	-	9,3	8,1	-	2,4	7,9	-	-	-	-	6,6	-	12,0	4,0	-	0,5	0,5	5,40	
		max	-	4,2	-	-	12,0	10,5	-	2,4	14,6	-	-	-	-	10,7	-	12,0	4,0	-	0,5	0,5	7,82	+45%
	MUH	min	-	1,9	-	-	1,1	1,0	-	2,4	1,1	-	-	1,2	-	2,1	-	1,3	4,0	-	0,5	0,5	1,47	-27%
		average	-	2,8	-	-	1,7	1,4	-	2,4	2,0	-	-	1,2	-	3,8	-	1,9	4,0	-	0,5	0,5	2,01	-63%
		max	-	4,2	-	-	2,2	1,8	-	2,4	3,1	-	-	1,2	-	6,2	-	2,4	4,0	-	0,5	0,5	2,89	+44%
	deviation from "common"			-24%			+47%	+28%		-35%	+33%					+40%		+87%	+8%		-87%	-87%		
S_Gas	SUH	min	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	8,72	-11%
		average	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	9,81	
		max	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	11,22	+14%
	MUH	min	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	8,72	-11%
		average	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	9,81	0%
		max	-	-	15,0	1,0	18,0	22,5	-	-	-	-	2,2	19,8	-	-	-	-	-	-	0,0	0,0	11,22	+14%
	deviation from "common"				+53%	-90%	+83%	+129%					-78%	+102%							-100%	-100%		
Other	SUH	min	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	0,0	1,03	-33%
		average	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	-	1,55	
		max	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	-	1,86	+20%
	MUH	min	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	-	1,24	-20%
		average	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	-	1,55	0%
		max	-	-	-	3,1	-	-	-	-	0,0	-	3,1	0,0	-	-	-	-	-	-	-	-	1,86	+20%
	deviation from "common"					+100%					-100%		+100%	-100%										

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Table 32: Portion of the dhw storage heat losses which is recoverable during the heating season differentiated by country and by building size class (data source: Tab.System.WS)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
S_D	SUH	min	-	-	2,0	1,6	2,3	1,9	-	0,0	-	-	0,0	-	-	-	-	1,2	1,5	-	0,2	0,0	1,0	-34%
		average	-	-	2,8	2,2	2,6	2,2	-	0,0	-	-	1,2	-	-	-	-	2,0	1,5	-	0,2	0,2	1,5	
		max	-	-	3,5	2,8	2,8	2,4	-	0,0	-	-	2,4	-	-	-	-	3,3	1,5	-	0,2	0,2	2,1	+40%
	MUH	min	-	-	2,0	1,6	2,3	1,9	-	0,0	-	-	0,0	-	-	-	-	1,2	1,5	-	0,2	0,2	1,0	-33%
		average	-	-	2,8	2,2	2,6	2,2	-	0,0	-	-	1,2	-	-	-	-	2,0	1,5	-	0,2	0,2	1,5	0%
		max	-	-	3,5	2,8	2,8	2,4	-	0,0	-	-	2,4	-	-	-	-	3,3	1,5	-	0,2	0,2	2,1	+40%
	deviation from "common"				+87%	+50%	+73%	+46%		-100%			-18%					+33%	+2%		-86%	-86%		
S_A	SUH	min	-	-	-	1,6	-	-	-	0,0	-	-	-	0,0	-	-	-	-	-	-	-	-	0,0	0,32	-40%
		average	-	-	-	1,6	-	-	-	0,0	-	-	-	0,0	-	-	-	-	-	-	-	-	-	0,53	
		max	-	-	-	1,6	-	-	-	0,0	-	-	-	0,0	-	-	-	-	-	-	-	-	-	0,80	+50%
	MUH	min	-	-	-	1,6	-	-	-	0,0	-	-	0,0	0,0	-	1,3	-	-	-	-	-	-	-	0,48	-40%
		average	-	-	-	1,6	-	-	-	0,0	-	-	0,0	0,0	-	2,4	-	-	-	-	-	-	-	0,81	+51%
		max	-	-	-	1,6	-	-	-	0,0	-	-	0,0	0,0	-	4,0	-	-	-	-	-	-	-	1,60	+98%
	deviation from "common"					+139%				-100%				-100%											
S_C_Int	SUH	min	-	1,0	-	2,8	4,3	3,6	2,9	0,0	1,9	4,6	0,0	0,0	1,3	1,5	2,9	6,3	1,5	1,0	0,0	0,0	1,87	-38%
		average	-	1,4	-	2,8	6,0	5,2	4,0	0,0	4,1	4,6	0,0	0,0	8,0	2,7	4,0	8,4	1,5	1,5	0,0	0,0	3,01	
		max	-	2,1	-	2,8	7,6	6,7	4,7	0,0	6,8	4,6	0,0	0,0	40,6	4,5	4,7	10,6	1,5	7,5	0,0	0,0	7,64	+154%
	MUH	min	-	1,0	-	2,8	0,8	0,6	0,6	0,0	0,5	4,6	0,0	0,0	3,0	0,9	0,6	1,3	1,5	1,0	0,0	0,0	1,01	-32%
		average	-	1,4	-	2,8	1,1	0,9	0,6	0,0	2,5	4,6	0,0	0,0	6,4	1,6	0,6	1,9	1,5	1,0	0,0	0,0	1,49	-50%
		max	-	2,1	-	2,8	1,4	1,2	0,6	0,0	6,8	4,6	0,0	0,0	13,1	2,6	0,6	2,4	1,5	1,0	0,0	0,0	2,84	+90%
	deviation from "common"			-37%		+24%	+57%	+34%	+4%	-100%	+46%	+102%	-100%	-100%	+218%	-4%	+4%	+129%	-33%	-44%	-100%	-100%		
S_C_Ext	SUH	min	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	-	-	0,0	-	0,0	0,0	-	0,5	0,0	0,05	-55%
		average	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	-	-	0,0	-	0,0	0,0	-	0,5	0,5	0,10	
		max	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	-	-	0,0	-	0,0	0,0	-	0,5	0,5	0,14	+36%
	MUH	min	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	0,0	-	0,0	-	0,0	0,0	-	0,5	0,5	0,08	-8%
		average	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	0,0	-	0,0	-	0,0	0,0	-	0,5	0,5	0,09	-9%
		max	-	0,0	-	-	0,0	0,0	-	0,0	0,0	-	-	0,0	-	0,0	-	0,0	0,0	-	0,5	0,5	0,13	+38%
	deviation from "common"			-100%			-100%	-100%		-100%	-100%					-100%		-100%	-100%		+424%	+424%		
S_Gas	SUH	min	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	1,21	-11%
		average	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	1,36	
		max	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	2,42	+78%
	MUH	min	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	1,21	-11%
		average	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	1,36	0%
		max	-	-	10,9	0,0	0,0	0,0	-	-	-	-	0,0	0,0	-	-	-	-	-	-	0,0	0,0	2,42	+78%
	deviation from "common"				+700%	-100%	-100%	-100%					-100%	-100%							-100%	-100%		
Other	SUH	min	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	0,0	0,00	
		average	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	-	0,00	
		max	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	-	0,00	
	MUH	min	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	-	0,00	
		average	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	-	0,00	
		max	-	-	-	0,0	-	-	-	-	0,0	-	0,0	0,0	-	-	-	-	-	-	-	-	0,00	
	deviation from "common"																							

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Table 33: Deviations of the storage heat losses from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
S_D	+60%		+26 %	+14%	+39%	-9%		+146 %			-27%					-45%	-16%		-94%	
S_A				-33%				+1%				+52%								+52%
S_C_Int	+294 %	-50%		+22%	+15%	-1%	-31%	-49%	-17%	+20 %	-58%	-16%	+68%	-14%	-31%	+8%	-37%	+55%	-89%	-16%
S_C_Ext		-24%			+47%	+28%		-35%	+33 %					+40%		+87%	+8%		-87%	
S_Gas			+53 %	-90%	+83%	+129 %					-78%	+102 %							-100%	+102%
Other				+100 %					-100%		+100 %	-100%								-100%

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Table 34: Annual heat loss of the dhw heat storage / merged and condensed values (data source: Tab.System.WS)

heat storage type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
S_D	decentral electric hot water storage	poor	9,2		6,0	5,0	6,0	3,6		10,2			2,8					3,3	3,0		0,2	0,2	7,4	+106%
		medium	5,7		4,5	4,1	5,0	3,3		8,8			2,6					2,0	3,0		0,2	0,2	3,6	
		high	4,3		3,0	3,1	3,9	2,9		7,3			2,4					1,2	3,0		0,2	0,0	1,4	-60%
	consideration in "common"		1		1	1	1	1		1			1					1	1		1	1	n=11	
S_C_Int	central hot water storage, inside of thermal envelope	poor	46,7	3,5		5,8	12,0	10,5	4,7	2,4	13,0	5,7	2,0	7,2	45,1	8,4	4,7	10,6	3,0	28,8	0,5	0,5	29,0	+511%
		medium	18,7	2,4		5,8	5,5	4,7	3,3	2,4	3,9	5,7	2,0	4,0	8,0	4,1	3,3	5,1	3,0	7,4	0,5	0,5	4,7	
		high	3,4	1,6		5,8	1,1	1,0	2,6	2,4	0,0	5,7	2,0	1,2	1,5	1,6	2,6	1,3	3,0	0,1	0,5	0,0	1,0	-79%
	consideration in "common"		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	n=19	
S_C_Ext	central hot water storage, outside of thermal envelope	poor		4,2			12,0	10,5		2,4	14,6			1,2		10,7		12,0	4,0		0,5	0,5	10,6	+202%
		medium		2,8			5,5	4,7		2,4	4,9			1,2		5,2		6,9	4,0		0,5	0,5	3,5	
		high		1,9			1,1	1,0		2,4	1,1			1,2		2,1		1,3	4,0		0,5	0,0	0,8	-79%
	consideration in "common"			1			1	1		1	1			1		1		1	1		1	1	n=11	
S_Gas	directly gas heated hot water storage	poor			15,0	1,0	18,0	22,5					2,2	19,8							0,0	0,0	16,2	+65%
		medium			15,0	1,0	18,0	22,5					2,2	19,8							0,0	0,0	9,8	
		high			15,0	1,0	18,0	22,5					2,2	19,8							0,0	0,0	4,9	-50%
	consideration in "common"				1	1	1	1					1	1							1	1	n=8	

Remarks

Determination of common values
all types: FR: not considered / 0 kWh/(m²a) is not plausible

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Table 35: Portion of the dhw storage heat losses which is recoverable during the heating season / merged and condensed values (data source: Tab.System.WS)

heat storage type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
S_D	decentral electric hot water storage	poor			3,5	2,8	2,8	2,4		0,0			2,4					3,3	1,5		0,2	0,2	2,7	+84%
		medium			2,8	2,2	2,6	2,2		0,0			1,2					2,0	1,5		0,2	0,2	1,5	
		high			2,0	1,6	2,3	1,9		0,0			0,0					1,2	1,5		0,2	0,0	0,5	-64%
	consideration in "common"				1	1	1	1		1			1					1	1		1	1	n=10	
S_C_Int	central hot water storage, inside of thermal envelope	poor		2,1		2,8	7,6	6,7	4,7	0,0	6,8	4,6	0,0	0,0	40,6	4,5	4,7	10,6	1,5	7,5	0,0	0,0	23,2	+931%
		medium		1,4		2,8	3,5	3,0	2,3	0,0	3,3	4,6	0,0	0,0	7,2	2,2	2,3	5,1	1,5	1,3	0,0	0,0	2,3	
		high		1,0		2,8	0,8	0,6	0,6	0,0	0,5	4,6	0,0	0,0	1,3	0,9	0,6	1,3	1,5	1,0	0,0	0,0	0,5	-78%
	consideration in "common"			1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	n=18	
S_C_Ext	central hot water storage, outside of thermal envelope	poor		0,0			0,0	0,0		0,0	0,0			0,0		0,0		0,0	0,0		0,5	0,5	0,3	+225%
		medium		0,0			0,0	0,0		0,0	0,0			0,0		0,0		0,0	0,0		0,5	0,5	0,1	
		high		0,0			0,0	0,0		0,0	0,0			0,0		0,0		0,0	0,0		0,5	0,0	0,0	-75%
	consideration in "common"			1			1	1		1	1			1		1		1	1		1	1	n=11	
S_Gas	directly gas heated hot water storage	poor			10,9	0,0	0,0	0,0					0,0	0,0							0,0	0,0	6,1	+350%
		medium			10,9	0,0	0,0	0,0					0,0	0,0							0,0	0,0	1,4	
		high			10,9	0,0	0,0	0,0					0,0	0,0							0,0	0,0	0,7	-50%
	consideration in "common"				1	1	1	1					1	1							1	1	n=8	

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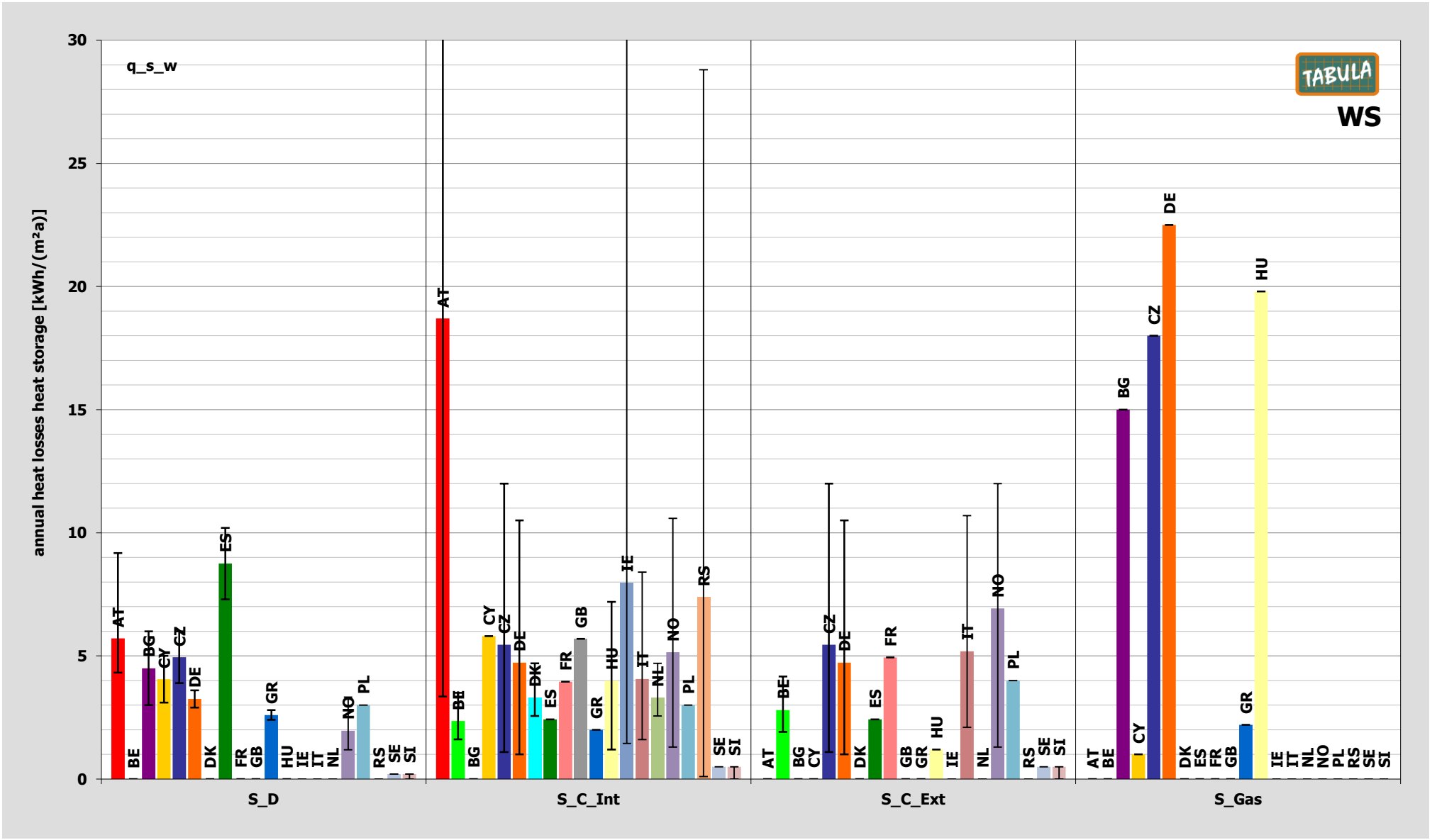
Figure 24: **Annual storage heat losses of DHW systems + recoverable fraction**

<S_D> decentral electric hot water storage; <S_C_Ent> central hot water storage, inside of thermal envelope; <S_C_Ext> central hot water storage, outside of thermal envelope; <S_Gas> directly gas heated hot water storage



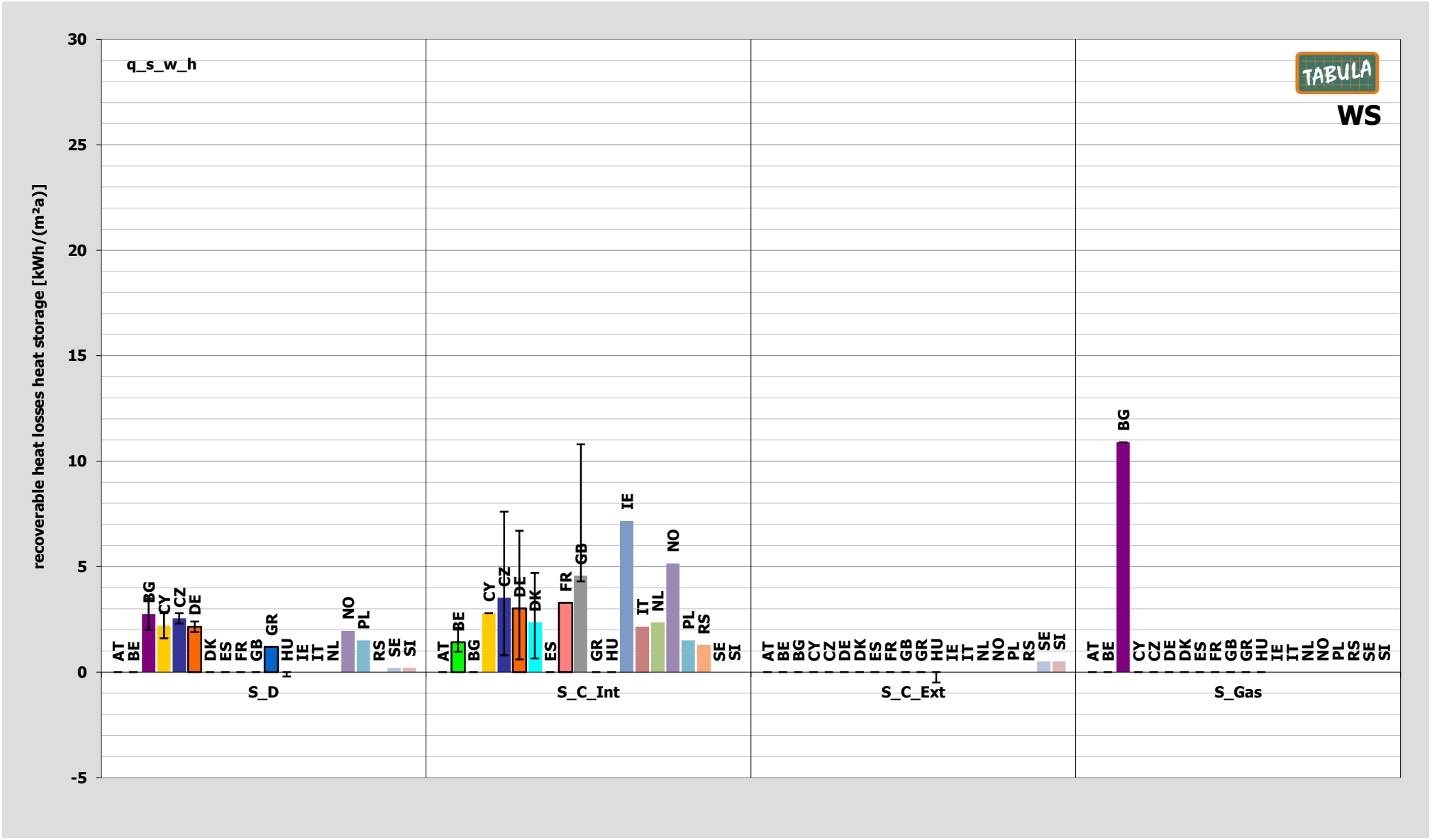

q_s_w_h
TABULA
WS
recoverable heat losses heat storage [kWh/(m²a)]
30
25
20
15
10
5
0
-5
AT BE BG CY CZ DE DK ES FR GB GR HU IE IT NL NO PL RS SE SI
S_D
S_C_Int
S_C_Ext
S_Gas

Table 36: Annual heat loss of the dhw heat storage / derived default values (simplified common values)

TABULA code	description	heat loss of the dhw distribution			thereof recoverable portion		
		annual heat losses per m² reference area			contribution to space heating per m² reference area		
		$q_{d,w}$			$q_{d,w,h}$		
		[kWh/(m²a)]			[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**	**poor**	**standard**	**high**
S_D	decentral electric hot water storage	7,4	3,6	1,4	2,7	1,5	1,5
S_C_Int	central hot water storage, inside of thermal envelope	29,0	4,7	1,0	23,2	2,3	2,3
S_C_Ext	central hot water storage, outside of thermal envelope	10,6	3,5	0,8	0,3	0,1	0,1
S_Gas	directly gas heated hot water storage	16,2	9,8	4,9	6,1	1,4	1,4

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4.8 WD – Domestic Hot Water Systems / Heat Distribution

Table 37: Annual heat losses of the dhw distribution / differentiated by country and by building size class (data source: Tab.System.WD)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
D	SUH	min	5,0	-	7,0	3,1	1,5	1,4	-	1,4	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	2,3	-24%
		average	5,0	-	7,0	3,1	3,3	3,0	-	3,0	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	3,0	
		max	5,0	-	7,0	3,1	5,1	4,6	-	4,6	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	3,8	+27%
	MUH	min	5,0	-	7,0	3,1	1,5	1,4	-	1,4	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	2,3	-24%
		average	5,0	-	7,0	3,1	3,3	3,0	-	3,0	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	3,0	0%
		max	5,0	-	7,0	3,1	5,1	4,6	-	4,6	0,0	-	0,9	-	-	-	3,1	-	-	1,5	-	-	3,8	+27%
	deviation from "common"		+67%		+134%	+4%	+10%	+0%		+0%	-100%		-70%				+4%			-50%				
C	SUH	min	-	-	-	8,0	-	-	-	-	-	-	2,8	-	-	-	-	-	-	-	-	-	4,53	-23%
		average	-	-	-	8,0	-	-	-	-	-	-	3,9	-	-	-	-	-	-	-	-	-	5,93	
		max	-	-	-	8,0	-	-	-	-	-	-	4,9	-	-	-	-	-	-	-	-	-	6,97	+18%
	MUH	min	-	-	-	8,0	-	-	-	-	-	-	2,8	-	-	-	-	-	-	-	-	-	4,53	-23%
		average	-	-	-	8,0	-	-	-	-	-	-	3,9	-	-	-	-	-	-	-	-	-	5,93	0%
		max	-	-	-	8,0	-	-	-	-	-	-	4,9	-	-	-	-	-	-	-	-	-	6,97	+18%
	deviation from "common"					+35%							-35%											
C_NoCirc_Int	SUH	min	14,0	0,5	12,0	3,8	4,4	4,4	4,5	-	0,0	-	1,5	3,0	2,9	0,8	4,4	4,5	-	3,0	-	0,6	3,78	-18%
		average	14,0	0,9	12,0	4,0	4,4	8,3	4,5	-	0,0	-	2,8	3,0	6,4	1,1	4,4	4,5	-	3,0	-	0,6	4,61	
		max	14,0	1,3	12,0	4,2	4,4	12,7	4,5	-	0,0	-	4,1	3,0	12,2	1,3	4,4	4,5	-	3,0	-	0,6	5,89	+28%
	MUH	min	14,0	0,8	15,0	3,8	4,4	4,4	-	-	0,0	-	1,5	3,0	2,9	-	4,4	-	-	3,0	-	0,6	4,13	-21%
		average	14,0	1,5	15,0	4,0	4,4	8,3	-	-	0,0	-	2,8	3,0	7,3	-	4,4	-	-	3,0	-	0,6	5,25	+14%
		max	14,0	2,1	15,0	4,2	4,4	12,7	-	-	0,0	-	4,1	3,0	12,2	-	4,4	-	-	3,0	-	0,6	6,76	+29%
	deviation from "common"		+184%	-76%	+174%	-19%	-11%	+68%			-100%		-43%	-39%	+39%		-11%			-39%		-88%		
C_NoCirc_Ext	SUH	min	-	-	-	7,8	-	4,4	-	4,4	0,0	-	1,8	-	-	-	7,8	-	13,2	4,0	-	-	4,82	-28%
		average	-	-	-	7,8	-	8,3	-	8,6	0,0	-	3,7	-	-	-	7,8	-	13,2	4,0	-	-	6,67	
		max	-	-	-	7,8	-	12,7	-	12,7	0,0	-	6,2	-	-	-	7,8	-	13,2	4,0	-	-	8,62	+29%
	MUH	min	-	-	-	7,8	-	4,4	-	4,4	-	-	1,8	-	-	-	7,8	-	8,0	4,0	-	-	5,00	-30%
		average	-	-	-	7,8	-	8,3	-	8,6	-	-	5,3	-	-	-	7,8	-	8,0	4,0	-	-	7,11	+7%
		max	-	-	-	7,8	-	12,7	-	12,7	-	-	10,4	-	-	-	7,8	-	8,0	4,0	-	-	9,51	+34%
	deviation from "common"					+13%		+20%		+24%			-34%				+13%		+54%	-42%				
NoCirc_A	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,4	-	-	-	-	-	4,40	0%
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,4	-	-	-	-	-	4,40	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,4	-	-	-	-	-	4,40	0%
	MUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	1,3	4,4	-	-	-	-	-	2,33	-22%
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	1,6	4,4	-	-	-	-	-	3,00	-32%
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	1,9	4,4	-	-	-	-	-	3,57	+19%
	deviation from "common"																+19%							
C_Circ_Int	SUH	min	7,1	13,4	-	2,1	6,5	6,5	-	-	-	0,2	2,4	-	-	2,2	7,3	-	4,7	-	0,0	1,0	4,11	-37%
		average	15,8	13,4	-	5,1	6,5	14,4	-	-	-	0,2	4,4	-	-	5,5	7,3	-	4,7	-	0,0	1,0	6,52	
		max	29,6	13,4	-	9,0	6,5	26,9	-	-	-	0,2	6,6	-	-	10,2	7,3	-	4,7	-	0,0	1,0	11,15	+71%
	MUH	min	7,1	9,5	22,0	2,1	-	6,4	7,7	-	-	0,2	1,5	-	-	2,0	7,3	7,7	4,7	-	15,0	1,0	6,29	-31%
		average	15,8	10,7	28,5	4,6	-	15,6	7,7	-	-	0,2	3,7	-	-	5,1	7,3	7,7	4,7	-	15,0	1,0	9,11	+40%
		max	29,6	11,9	35,0	9,0	-	30,9	7,7	-	-	0,2	6,6	-	-	9,1	7,3	7,7	4,7	-	15,0	1,0	14,05	+54%
	deviation from "common"		+103%	+54%		-38%		+92%				-97%	-49%			-32%	-7%		-40%		-4%	-87%		
C_Circ_Ext	SUH	min	-	45,1	-	5,7	7,1	6,5	-	-	-	-	1,8	-	-	3,0	15,7	-	-	6,0	-	-	10,30	-33%
		average	-	45,1	-	14,2	15,8	14,4	-	-	-	-	5,0	-	-	7,5	15,7	-	-	6,0	-	-	15,46	
		max	-	45,1	-	22,0	29,6	26,9	-	-	-	-	9,5	-	-	13,9	15,7	-	-	6,0	-	-	23,76	+54%
	MUH	min	-	30,2	-	5,7	7,0	6,4	-	6,4	0,0	-	1,8	3,9	-	2,8	15,7	-	9,8	6,0	-	-	7,36	-40%
		average	-	34,3	-	12,3	17,2	15,6	-	18,7	0,0	-	6,6	3,9	-	7,0	15,7	-	9,8	6,0	-	-	12,25	-21%
		max	-	38,4	-	22,0	34,0	30,9	-	30,9	0,0	-	16,0	3,9	-	12,4	15,7	-	9,8	6,0	-	-	19,88	+62%
	deviation from "common"			+186%		-4%	+19%	+8%					-58%			-48%	+13%			-57%				
Circ_A	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		min	-	-	-	-	-	-	-	0,8	-	-	0,8	-	-	-	-	-	-	-	-	-	0,80	-36%
	MUH	average	-	-	-	-	-	-	-	1,4	-	-	1,2	-	-	-	-	-	-	-	-	-	1,25	
		max	-	-	-	-	-	-	-	1,9	-	-	1,5	-	-	-	-	-	-	-	-	-	1,77	+41%
	deviation from "common"																							

Table 38: Portion of the dhw distribution heat losses which is recoverable during the heating season / differentiated by country and by building size class
(data source: Tab.System.WD)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
D		min	3,0	-	4,0	1,1	0,9	0,8	-	0,8	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	1,4	-24%
	SUH	average	3,0	-	4,0	1,1	2,1	1,9	-	1,9	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	1,9	
		max	3,0	-	4,0	1,1	3,3	3,0	-	3,0	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	2,4	+30%
		min	3,0	-	4,0	1,1	0,9	0,8	-	0,8	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	1,4	-24%
	MUH	average	3,0	-	4,0	1,1	2,1	1,9	-	1,9	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	1,9	0%
		max	3,0	-	4,0	1,1	3,3	3,0	-	3,0	-	-	0,9	-	-	-	1,1	-	-	0,8	-	-	2,4	+30%
	deviation from "common"		+61%		+114 %	-41%	+13%	+2%		+2%			-52%				-41%			-57%				
C		min	-	-	-	1,1	-	-	-	-	-	-	0,3	-	-	-	-	-	-	-	-	-	0,57	-35%
	SUH	average	-	-	-	1,1	-	-	-	-	-	-	0,7	-	-	-	-	-	-	-	-	-	0,88	
		max	-	-	-	1,1	-	-	-	-	-	-	1,0	-	-	-	-	-	-	-	-	-	1,07	+22%
		min	-	-	-	1,1	-	-	-	-	-	-	0,3	-	-	-	-	-	-	-	-	-	0,57	-35%
	MUH	average	-	-	-	1,1	-	-	-	-	-	-	0,7	-	-	-	-	-	-	-	-	-	0,88	0%
		max	-	-	-	1,1	-	-	-	-	-	-	1,0	-	-	-	-	-	-	-	-	-	1,07	+22%
	deviation from "common"					+26%							-26%											
C_NoCirc_Int		min	6,6	0,3	5,2	1,1	2,0	2,6	1,1	-	-	-	1,2	0,0	2,3	0,4	1,1	1,1	-	1,2	-	0,5	1,67	-25%
	SUH	average	6,6	0,6	5,2	1,1	2,0	4,9	1,1	-	-	-	2,3	0,0	5,2	0,5	1,1	1,1	-	1,2	-	0,5	2,22	
		max	6,6	0,8	5,2	1,1	2,0	7,6	1,1	-	-	-	3,3	0,0	9,8	0,6	1,1	1,1	-	1,2	-	0,5	3,24	+46%
		min	6,6	0,5	7,1	1,1	2,0	2,6	-	-	-	-	1,2	0,0	2,3	-	1,1	-	-	1,2	-	0,5	2,02	-28%
	MUH	average	6,6	0,9	7,1	1,1	2,0	4,9	-	-	-	-	2,3	0,0	5,9	-	1,1	-	-	1,2	-	0,5	2,79	+26%
		max	6,6	1,3	7,1	1,1	2,0	7,6	-	-	-	-	3,3	0,0	9,8	-	1,1	-	-	1,2	-	0,5	3,95	+41%
	deviation from "common"		+163 %	-71%	+145 %	-56%	-20%	+97%					-10%	-100%	+119 %		-56%			-52%		-80%		
C_NoCirc_Ext		min	-	-	-	1,7	-	1,7	-	1,7	-	-	1,0	-	-	-	1,7	-	6,8	1,2	-	-	2,10	-29%
	SUH	average	-	-	-	1,7	-	3,8	-	3,9	-	-	1,5	-	-	-	1,7	-	6,8	1,2	-	-	2,94	
		max	-	-	-	1,7	-	6,0	-	6,0	-	-	2,9	-	-	-	1,7	-	6,8	1,2	-	-	4,14	+41%
		min	-	-	-	1,7	-	1,7	-	1,7	-	-	1,1	-	-	-	1,7	-	4,2	1,2	-	-	1,80	-30%
	MUH	average	-	-	-	1,7	-	3,8	-	3,9	-	-	1,6	-	-	-	1,7	-	4,2	1,2	-	-	2,58	-12%
		max	-	-	-	1,7	-	6,0	-	6,0	-	-	2,9	-	-	-	1,7	-	4,2	1,2	-	-	3,71	+44%
	deviation from "common"					-38%		+39%		+39%			-44%				-38%		+99%	-57%				
NoCirc_A		min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,1	-	-	-	-	-	1,10	0%
	SUH	average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,1	-	-	-	-	-	1,10	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,1	-	-	-	-	-	1,10	0%
		min	-	-	-	-	-	-	-	-	-	-	-	-	-	0,6	1,1	-	-	-	-	-	0,77	-19%
	MUH	average	-	-	-	-	-	-	-	-	-	-	-	-	-	0,8	1,1	-	-	-	-	-	0,95	-14%
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	1,0	1,1	-	-	-	-	-	1,07	+12%
	deviation from																+7%							

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
	"common"																							
C_Circ_Int	SUH	min	2,7	8,1	-	1,4	3,9	3,9	-	-	-	0,2	1,9	-	-	0,4	1,4	-	1,8	-	6,0	0,8	2,52	-32%
		average	7,7	8,1	-	1,5	3,9	8,6	-	-	-	0,2	3,5	-	-	1,1	1,4	-	1,8	-	6,0	0,8	3,71	
		max	15,3	8,1	-	1,6	3,9	16,1	-	-	-	0,2	5,3	-	-	2,0	1,4	-	1,8	-	6,0	0,8	6,05	+63%
	MUH	min	2,7	3,8	7,0	1,4	-	3,8	1,9	-	-	0,2	1,2	-	-	0,4	1,4	1,9	1,8	-	6,0	0,8	2,30	-35%
		average	7,7	4,3	8,5	1,5	-	9,4	1,9	-	-	0,2	2,9	-	-	1,0	1,4	1,9	1,8	-	6,0	0,8	3,51	-5%
		max	15,3	4,7	10,0	1,6	-	18,5	1,9	-	-	0,2	5,3	-	-	1,8	1,4	1,9	1,8	-	6,0	0,8	5,98	+70%
	deviation from "common"		+113 %	+71%		-60%		+149 %				-94%	-11%			-71%	-61%		-50%		+66%	-78%		
C_Circ_Ext	SUH	min	-	27,1	-	2,5	2,7	2,5	-	-	-	-	1,0	-	-	0,6	2,5	-	-	2,5	-	-	4,67	-32%
		average	-	27,1	-	4,3	7,7	7,0	-	-	-	-	2,1	-	-	1,5	2,5	-	-	2,5	-	-	6,83	
		max	-	27,1	-	7,0	15,3	13,9	-	-	-	-	4,7	-	-	2,8	2,5	-	-	2,5	-	-	11,43	+67%
	MUH	min	-	12,1	-	2,5	3,2	2,9	-	2,9	-	-	1,1	0,0	-	0,6	2,5	-	7,1	2,5	-	-	3,12	-44%
		average	-	13,8	-	3,6	9,4	8,5	-	10,3	-	-	2,1	0,0	-	1,4	2,5	-	7,1	2,5	-	-	5,56	-19%
		max	-	15,4	-	7,0	19,4	17,6	-	17,6	-	-	4,7	0,0	-	2,5	2,5	-	7,1	2,5	-	-	9,64	+73%
	deviation from "common"			+230 %		-36%	+38%	+25%					-66%			-77%	-60%			-60%				
Circ_A	SUH	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	MUH	min	-	-	-	-	-	-	-	0,8	-	-	0,8	-	-	-	-	-	-	-	-	-	0,80	-16%
		average	-	-	-	-	-	-	-	0,9	-	-	1,0	-	-	-	-	-	-	-	-	-	0,95	
		max	-	-	-	-	-	-	-	1,0	-	-	1,2	-	-	-	-	-	-	-	-	-	1,13	+19%
	deviation from "common"																							

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Table 39: Deviations of the distribution heat losses from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
D	+67%		+134%	+4%	+10%	+0%		+0%	-100%		-70%				+4%			-50%		
C				+35%							-35%									
C_NoCirc_Int	+184%	-76%	+174%	-19%	-11%	+68%			-100%		-43%	-39%	+39%		-11%			-39%		-88%
C_NoCirc_Ext				+13%		+20%		+24%			-34%				+13%		+54%	-42%		
NoCirc_A															+19%					
C_Circ_Int	+103%	+54%		-38%		+92%				-97%	-49%			-32%	-7%		-40%		-4%	-87%
C_Circ_Ext		+186%		-4%	+19%	+8%					-58%			-48%	+13%			-57%		
Circ_A																				

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Table 40: Annual heat losses of the dhw distribution / merged and condensed values (data source: Tab.System.WD)

heat distribution type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
D	decentral DHW system	poor	5,0		7,0	3,1	5,1	4,6		4,6	0,0		0,9				3,1			1,5			5,2	+75%
		medium	5,0		7,0	3,1	3,3	3,0		3,0	0,0		0,9				3,1			1,5			3,0	
		high	5,0		7,0	3,1	1,5	1,4		1,4	0,0		0,9				3,1			1,5			1,2	-58%
	consideration in "common"		1		1	1	1	1		1	1		1				1			1			n=10	
C_NoCirc_Int	central DHW distribution, all pipes inside of thermal envelope, no circulation	poor	14,0	2,1	15,0	4,2	4,4	12,7	4,5		0,0		4,1	3,0	12,2	1,3	4,4	4,5		3,0		0,6	10,3	+117%
		medium	14,0	1,2	13,5	4,0	4,4	8,3	4,5		0,0		2,8	3,0	6,9	1,1	4,4	4,5		3,0		0,6	4,8	
		high	14,0	0,5	12,0	3,8	4,4	4,4	4,5		0,0		1,5	3,0	2,9	0,8	4,4	4,5		3,0		0,6	2,0	-58%
	consideration in "common"		1	1	1	1	1	1	1		1		1	1	1	1	1	1		1		1	n=16	
C_NoCirc_Ext	central DHW distribution, fraction of pipeline outside of thermal envelope, no circulation	poor				7,8		12,7		12,7	0,0		10,4				7,8		13,2	4,0			10,9	+69%
		medium				7,8		8,3		8,6	0,0		4,5				7,8		10,6	4,0			6,4	
		high				7,8		4,4		4,4	0,0		1,8				7,8		8,0	4,0			2,4	-63%
	consideration in "common"					1		1		1	1		1				1		1	1			n=8	
C_Circ_Int	central DHW distribution with circulation, all pipes inside of thermal envelope	poor	29,6	13,4	35,0	9,0	6,5	30,9	7,7			0,2	6,6			10,2	7,3	7,7	4,7		15,0	1,0	23,0	+185%
		medium	15,8	12,1	28,5	4,8	6,5	15,0	7,7			0,2	4,0			5,3	7,3	7,7	4,7		7,5	1,0	8,1	
		high	7,1	9,5	22,0	2,1	6,5	6,4	7,7			0,2	1,5			2,0	7,3	7,7	4,7		0,0	1,0	2,8	-65%
	consideration in "common"		1	1	1	1	1		1			1	1			1	1	1	1		1	1	n=14	
C_Circ_Ext	central DHW distribution with circulation, fraction of pipeline outside of thermal envelope	poor		45,1		22,0	34,0	30,9		30,9	0,0		16,0	3,9		13,9	15,7		9,8	6,0			32,1	+154%
		medium		39,7		13,2	16,5	15,0		18,7	0,0		5,8	3,9		7,2	15,7		9,8	6,0			12,6	
		high		30,2		5,7	7,0	6,4		6,4	0,0		1,8	3,9		2,8	15,7		9,8	6,0			4,0	-68%
	consideration in "common"			1		1	1	1		1	1		1	1		1	1		1	1			n=12	

Remarks

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Determination of common values

all systems FR: not considered / 0 kWh/(m²a) is not plausible

Table 41: Portion of the dhw distribution heat losses which is recoverable during the heating season / merged and condensed values

(data source: Tab.System.WD)

heat distribution type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
D	decentral DHW system	poor	3,0		4,0	1,1	3,3	3,0		3,0			0,9				1,1			0,8			3,1	+67%
		medium	3,0		4,0	1,1	2,1	1,9		1,9			0,9				1,1			0,8			1,9	
		high	3,0		4,0	1,1	0,9	0,8		0,8			0,9				1,1			0,8			1,1	-39%
	consideration in "common"		1		1	1	1	1		1			1				1			1			n=9	
C_NoCirc_Int	central DHW distribution, all pipes inside of thermal envelope, no circulation	poor	6,6	1,3	7,1	1,1	2,0	7,6	1,1				3,3	0,0	9,8	0,6	1,1	1,1		1,2		0,5	6,4	+175%
		medium	6,6	0,7	6,2	1,1	2,0	4,9	1,1				2,3	0,0	5,5	0,5	1,1	1,1		1,2		0,5	2,3	
		high	6,6	0,3	5,2	1,1	2,0	2,6	1,1				1,2	0,0	2,3	0,4	1,1	1,1		1,2		0,5	0,9	-62%
	consideration in "common"		1	1	1	1	1	1	1				1	1	1	1	1	1		1		1	n=15	
C_NoCirc_Ext	central DHW distribution, fraction of pipeline outside of thermal envelope, no circulation	poor				1,7		6,0		6,0			2,9				1,7		6,8	1,2			5,3	+91%
		medium				1,7		3,8		3,9			1,6				1,7		5,5	1,2			2,8	
		high				1,7		1,7		1,7			1,0				1,7		4,2	1,2			1,4	-48%
	consideration in "common"					1		1		1			1				1		1	1			n=7	
C_Circ_Int	central DHW distribution with circulation, all pipes inside of thermal envelope	poor	15,3	8,1	10,0	1,6	3,9	18,5	1,9			0,2	5,3			2,0	1,4	1,9	1,8		6,0	0,8	11,9	+224%
		medium	7,7	6,2	8,5	1,5	3,9	9,0	1,9			0,2	3,2			1,0	1,4	1,9	1,8		6,0	0,8	3,7	
		high	2,7	3,8	7,0	1,4	3,9	3,8	1,9			0,2	1,2			0,4	1,4	1,9	1,8		6,0	0,8	1,4	-63%
	consideration in "common"		1	1	1	1	1	1	1			1	1			1	1	1	1		1	1	n=15	
C_Circ_Ext	central DHW distribution with circulation, fraction of pipeline outside of thermal envelope	poor		27,1		7,0	19,4	17,6		17,6			4,7	0,0		2,8	2,5		7,1	2,5			18,5	+205%
		medium		20,4		4,0	8,6	7,8		10,3			2,1	0,0		1,5	2,5		7,1	2,5			6,1	
		high		12,1		2,5	2,7	2,5		2,9			1,0	0,0		0,6	2,5		7,1	2,5			1,7	-73%
	consideration in "common"			1		1	1	1		1			1	1		1	1		1	1			n=11	

Remarks

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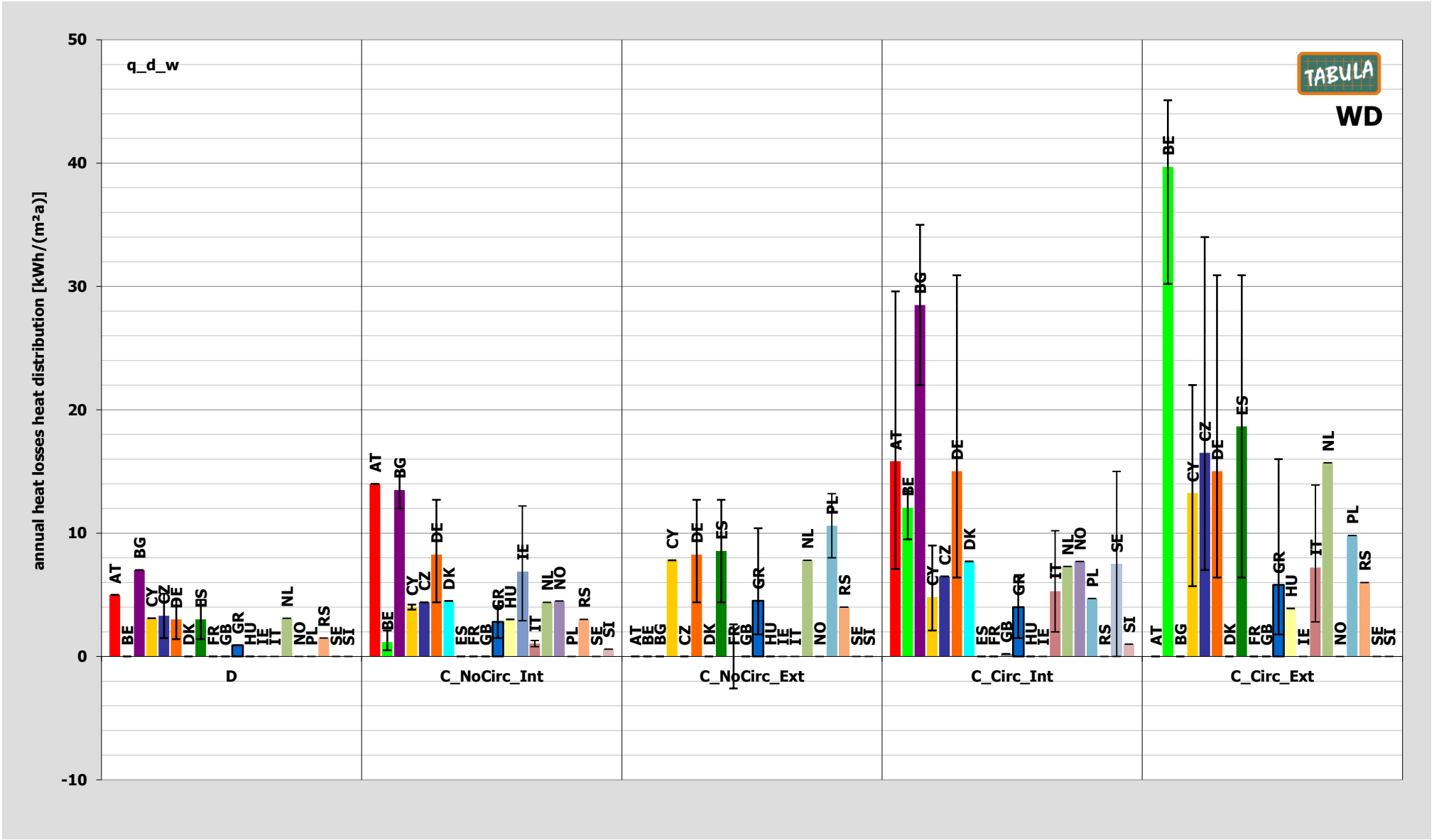
Determination of common values

all systems FR: not considered / 0 kWh/(m²a) is not plausible

Figure 25: **Annual distribution heat losses of DHW systems + recoverable fraction**

<D> decentral DHW system; <C_NoCirc_Int> central DHW distribution, all pipes inside of thermal envelope, no circulation; <C_NoCirc_ext> central DHW distribution, fraction of pipeline outside of thermal envelope, no circulation; <C_Circ_Int> central DHW distribution with circulation, all pipes inside of thermal envelope; <C_Circ_Ext> central DHW distribution with circulation, fraction of pipeline outside of thermal envelope



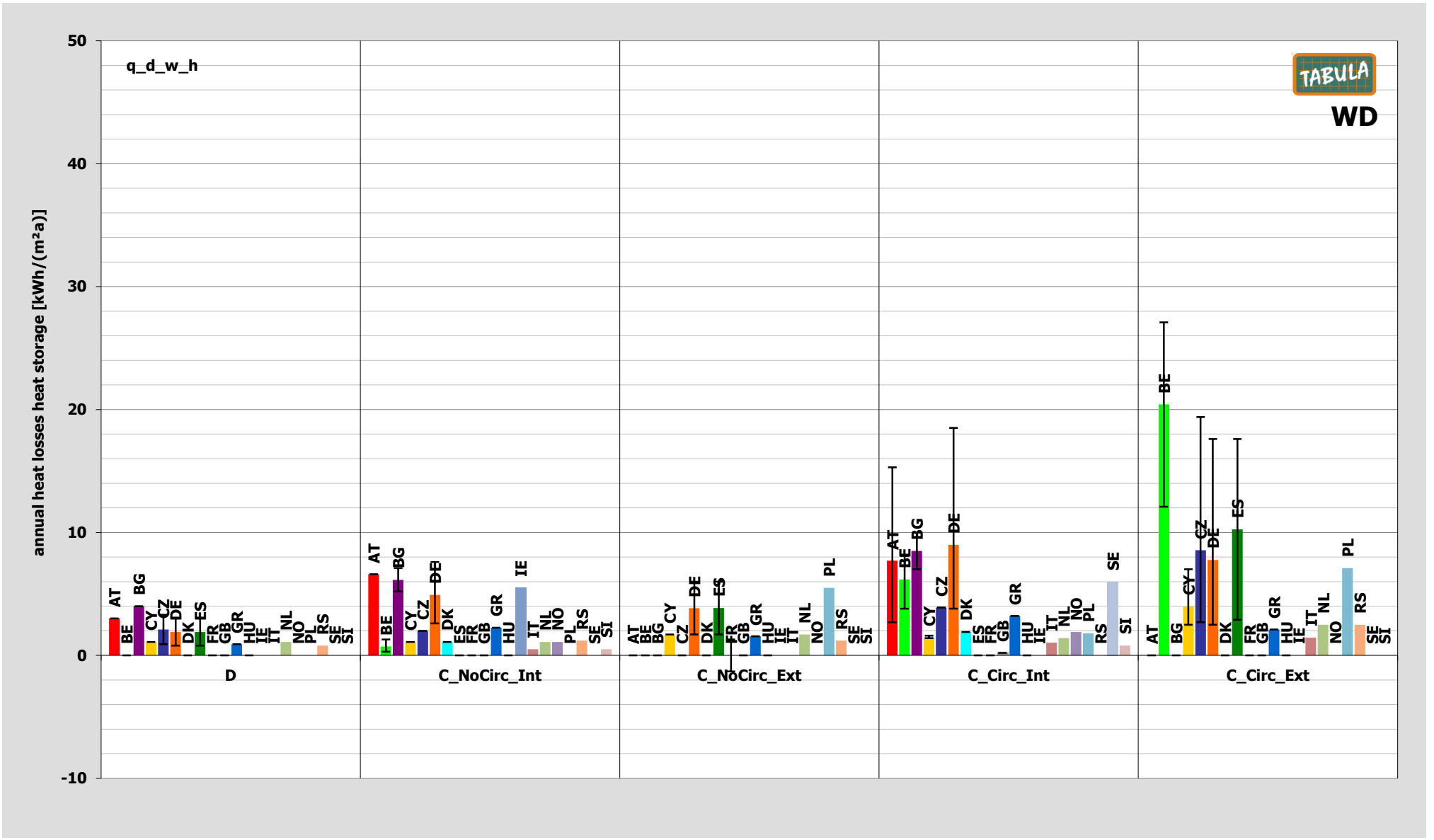

q_d_w_h
TABULA
WD
annual heat losses heat storage [kWh/(m²a)]
50
40
30
20
10
0
-10
D
C_NoCirc_Int
C_NoCirc_Ext
C_Circ_Int
C_Circ_Ext

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Table 42: Annual heat losses of the dhw distribution / derived default values (simplified common values)

TABULA code	description	heat loss of the dhw distribution			thereof recoverable portion		
		annual heat losses per m² reference area			contribution to space heating per m² reference area		
		$q_{d,w}$			$q_{d,w,h}$		
		[kWh/(m²a)]			[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**	**poor**	**standard**	**high**
D	decentral DHW system	5,2	3,0	1,2	1,9	1,1	1,1
C_NoCirc_Int	central DHW distribution, all pipes inside of thermal envelope, no circulation	10,3	4,8	2,0	2,3	0,9	0,9
C_NoCirc_Ext	central DHW distribution, fraction of pipeline outside of thermal envelope, no circulation	10,9	6,4	2,4	2,8	1,4	1,4
C_Circ_Int	central DHW distribution with circulation, all pipes inside of thermal envelope	23,0	8,1	2,8	3,7	1,4	1,4
C_Circ_Ext	central DHW distribution with circulation, fraction of pipeline outside of thermal envelope	32,1	12,6	4,0	6,1	1,7	1,7

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4.9 WA – DHW Systems / Auxiliary Energy

Table 43: Annual auxiliary electricity demand of DHW systems differentiated by country and by building size class (data source: Tab.System.WA)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
D	SUH	min	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	-	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	
		average	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	-	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	
		max	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	-	-	0,0	-	0,0	0,0	0,0	0,0	-	0,0	
	MUH	min	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	-	-	0,0	0,3	-	0,0	-	0,0	0,0	0,0	-	-	0,0	-7%
		average	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	-	-	0,0	0,3	-	0,0	-	0,0	0,0	0,0	-	-	0,0	
		max	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	-	-	0,0	0,3	-	0,0	-	0,0	0,0	0,0	-	-	0,0	+86%
	deviation from "common"		-100%		-100%	-100%	-100%	-100%	-100%	-100%			-100%			-100%		-100%	-100%	-100%				
C_NoCirc	SUH	min	0,2	0,0	0,0	0,2	0,4	0,4	-	-	0,0	-	0,1	0,2	-	-	0,0	-	0,6	1,0	0,0	0,0	0,2	-40%
		average	0,2	1,5	0,0	0,3	0,4	0,4	-	-	0,0	-	0,3	0,2	-	-	0,0	-	0,6	1,0	0,0	0,0	0,3	
		max	0,2	3,1	0,0	0,4	0,4	0,4	-	-	0,0	-	0,4	0,3	-	-	0,0	-	0,6	1,0	0,0	0,0	0,7	+91%
	MUH	min	0,2	0,0	0,0	0,2	0,4	0,2	-	-	0,0	-	0,1	-	-	-	0,0	-	-	1,0	-	-	0,2	-50%
		average	0,2	1,5	0,0	0,3	0,4	0,2	-	-	0,0	-	0,3	-	-	-	0,0	-	-	1,0	-	-	0,4	
		max	0,2	3,1	0,0	0,4	0,4	0,2	-	-	0,0	-	0,4	-	-	-	0,0	-	-	1,0	-	-	0,8	+109%
	deviation from "common"		-45%	+305%	-100%	-18%	+10%	-18%			-100%		-31%				-100%			+174%				
C_Circ	SUH	min	0,9	-	-	0,1	1,6	1,4	-	-	-	-	0,2	-	-	3,2	-	-	1,4	1,5	-	1,7	1,2	-17%
		average	0,9	-	-	0,2	1,6	1,4	-	-	-	-	0,4	-	-	4,1	-	-	1,4	1,5	-	1,7	1,5	
		max	0,9	-	-	0,3	1,6	1,4	-	-	-	-	0,6	-	-	4,6	-	-	1,4	1,5	-	1,7	1,9	+27%
	MUH	min	0,9	-	1,1	0,1	1,2	0,8	-	-	0,9	-	0,2	0,3	-	2,0	-	-	1,4	1,5	0,7	1,7	0,9	-24%
		average	0,9	-	1,1	0,2	1,2	0,8	-	-	0,9	-	0,4	2,1	-	2,4	-	-	1,4	1,5	1,1	1,7	1,2	
		max	0,9	-	1,1	0,3	1,2	0,8	-	-	0,9	-	0,6	3,9	-	2,8	-	-	1,4	1,5	1,4	1,7	1,6	+33%
	deviation from "common"		-33%			-85%	+5%	-18%					-70%			+143%			+5%	+12%		+27%		
C_NoCirc_Sol	SUH	min	1,3	2,5	1,5	1,1	-	1,2	0,8	-	1,1	-	0,5	1,3	-	-	0,0	0,8	-	1,5	0,4	-	1,0	-11%
		average	1,3	2,5	1,5	1,2	-	1,2	0,9	-	1,1	-	0,9	1,3	-	-	0,0	0,9	-	1,5	0,5	-	1,1	
		max	1,3	2,5	1,5	1,2	-	1,2	0,9	-	1,1	-	1,2	1,3	-	-	0,0	0,9	-	1,5	0,5	-	1,3	+12%
	MUH	min	1,3	2,5	1,5	1,1	-	0,6	0,8	0,6	-	-	0,5	-	-	-	0,0	0,8	-	1,5	-	-	0,9	-12%
		average	1,3	2,5	1,5	1,2	-	0,6	0,9	0,6	-	-	0,9	-	-	-	0,0	0,9	-	1,5	-	-	1,1	
		max	1,3	2,5	1,5	1,2	-	0,6	0,9	0,6	-	-	1,2	-	-	-	0,0	0,9	-	1,5	-	-	1,2	+15%
	deviation from "common"		+19%	+129%	+37%	+5%		-18%	-22%				-22%				-100%	-22%		+37%				
C_Circ_Sol	SUH	min	-	4,7	-	1,3	2,5	2,2	-	-	-	-	0,7	-	-	4,1	-	-	1,4	2,0	-	-	2,2	-15%
		average	-	4,7	-	1,9	2,5	2,2	-	-	-	-	1,3	-	-	4,5	-	-	1,4	2,0	-	-	2,6	
		max	-	4,7	-	2,4	2,5	2,2	-	-	-	-	1,9	-	-	4,9	-	-	1,4	2,0	-	-	3,0	+17%
	MUH	min	-	4,7	-	1,3	1,5	1,3	-	1,3	1,6	-	0,7	0,8	-	2,2	-	-	1,4	2,0	1,6	-	1,6	-12%
		average	-	4,7	-	1,9	1,5	1,3	-	1,3	1,6	-	1,3	0,8	-	2,4	-	-	1,4	2,0	2,0	-	1,8	
		max	-	4,7	-	2,4	1,5	1,3	-	1,3	1,6	-	1,9	0,8	-	2,5	-	-	1,4	2,0	2,3	-	2,2	+19%
	deviation from "common"			+114%		-16%	-9%	-20%					-41%			+56%			-36%	-9%				

Table 44: Deviations from averages ("common values") per country

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
D	-100%		-100%	-100%	-100%	-100%	-100%	-100%			-100%			-100%		-100%	-100%	-100%		
C_NoCirc	-45%	+305%	-100%	-18%	+10%	-18%			-100%		-31%				-100%			+174%		
C_Circ	-33%			-85%	+5%	-18%					-70%			+143%			+5%	+12%		+27%
C_NoCirc_Sol	+19%	+129%	+37%	+5%		-18%	-22%				-22%				-100%	-22%		+37%		
C_Circ_Sol		+114%		-16%	-9%	-20%					-41%			+56%			-36%	-9%		

Table 45: Annual auxiliary electricity demand of DHW systems / merged and condensed values (data source: Tab.System.WA)

dhw system type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
D	decentral DHW system	poor	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,3		0,0		0,0	0,0	0,0	0,0		0,2	+700%
		medium	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,3		0,0		0,0	0,0	0,0	0,0		0,0	
		high	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,3		0,0		0,0	0,0	0,0	0,0		0,0	-50%
	consideration in "common"		1		1	1	1	1	1	1	1		1	1		1		1	1	1	1		n=15	
C_NoCirc	central DHW system, no circulation	poor	0,2	3,1	0,0	0,4	0,4	0,4			0,0		0,4	0,3			0,0		0,6	1,0	0,0	0,0	1,8	+428%
		medium	0,2	1,5	0,0	0,3	0,4	0,3			0,0		0,3	0,2			0,0		0,6	1,0	0,0	0,0	0,3	
		high	0,2	0,0	0,0	0,2	0,4	0,2			0,0		0,1	0,2			0,0		0,6	1,0	0,0	0,0	0,1	-69%
	consideration in "common"		1	1	1	1	1	1			1		1	1			1		1	1	1	1	n=14	
C_Circ	central DHW system with circulation	poor	0,9		1,1	0,3	1,6	1,4			0,9		0,6	3,9		4,6			1,4	1,5	1,4	1,7	3,1	+139%
		medium	0,9		1,1	0,2	1,4	1,1			0,9		0,4	2,1		3,3			1,4	1,5	1,1	1,7	1,3	
		high	0,9		1,1	0,1	1,2	0,8			0,9		0,2	0,3		2,0			1,4	1,5	0,7	1,7	0,5	-59%
	consideration in "common"		1		1	1	1	1			1		1	1		1			1	1	1	1	n=13	
C_NoCirc_Sol	central DHW system with solar thermal system, no circulation	poor	1,3	2,5	1,5	1,2		1,2	0,9	0,6	1,1		1,2	1,3			0,0	0,9		1,5	0,5		1,8	+71%
		medium	1,3	2,5	1,5	1,2		0,9	0,9	0,6	1,1		0,9	1,3			0,0	0,9		1,5	0,5		1,1	
		high	1,3	2,5	1,5	1,1		0,6	0,8	0,6	1,1		0,5	1,3			0,0	0,8		1,5	0,4		0,5	-53%
	consideration in "common"		1	1	1	1		1	1	1	1		1	1			1	1		1	1		n=14	
C_Circ_Sol	central DHW system with solar thermal system and circulation	poor		4,7		2,4	2,5	2,2		1,3	1,6		1,9	0,8		4,9			1,4	2,0	2,3		3,6	+80%
		medium		4,7		1,9	2,0	1,8		1,3	1,6		1,3	0,8		3,4			1,4	2,0	2,0		2,0	
		high		4,7		1,3	1,5	1,3		1,3	1,6		0,7	0,8		2,2			1,4	2,0	1,6		1,2	-40%
	consideration in "common"			1		1	1	1		1	1		1	1		1			1	1	1		n=12	

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Figure 26: **Annual auxiliary electricity demand of DHW systems /**

<D> decentral DHW system; <C_NoCirc> central DHW system, no circulation; <C_Circ> central DHW system with circulation; <C_NoCirc_Sol> central DHW system with solar thermal system, no circulation; <C_Circ_Sol> central DHW system with solar thermal system and circulation

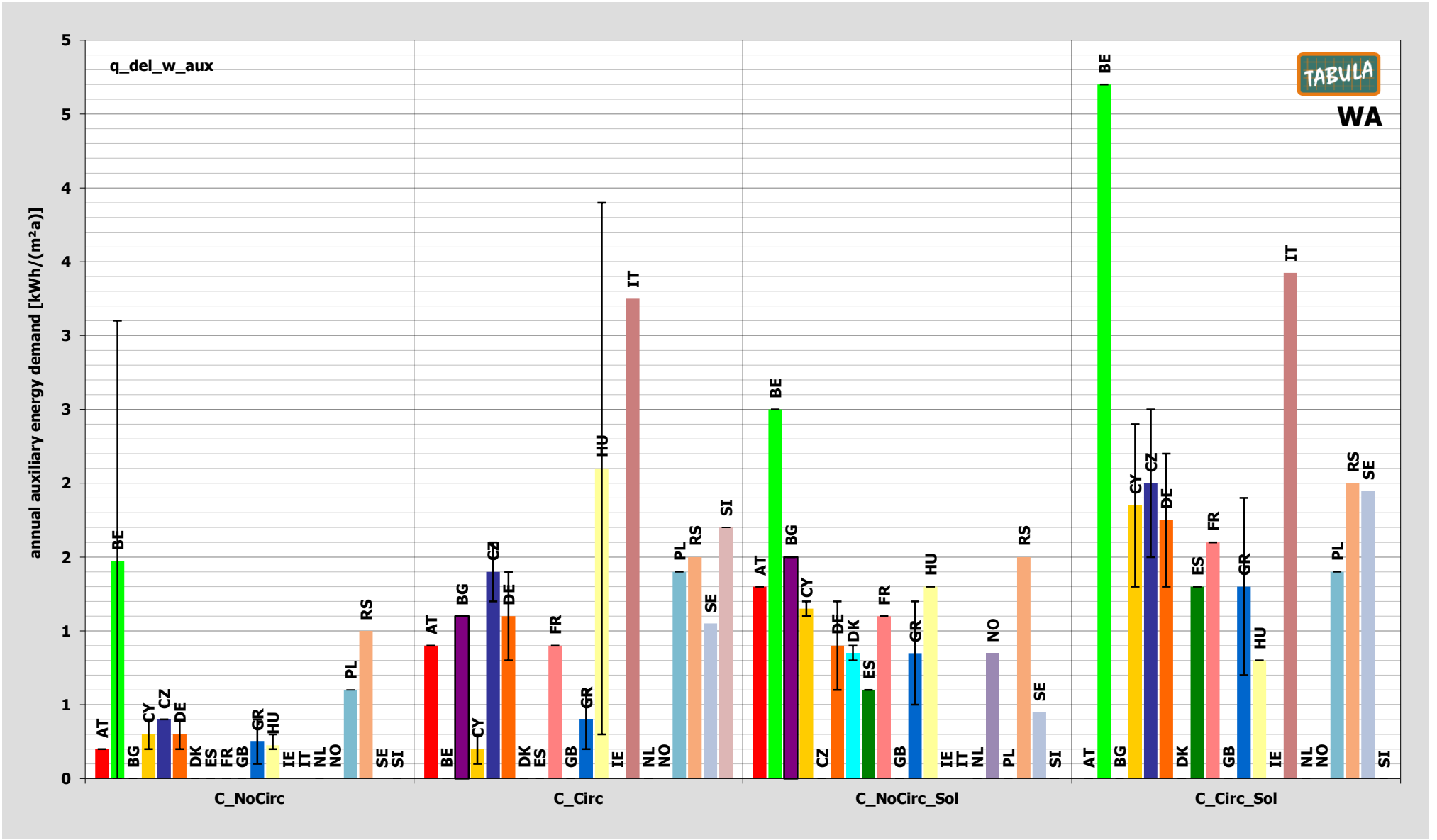

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Table 46: Annual auxiliary electricity demand of DHW systems / derived default values (simplified common values)

TABULA code	description	auxiliary energy demand (electricity) of dhw systems		
		annual values in kWh per m² reference area for heat generation (blower, control), storage (pump), distribution (pump), as far as available		
		$q_{del,w,aux}$		
		[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**
D	decentral DHW system	0,2	0,0	0,0
C_NoCirc	central DHW system, no circulation	1,8	0,3	0,1
C_Circ	central DHW system with circulation	3,1	1,3	0,5
C_NoCirc_Sol	central DHW system with solar thermal system, no circulation	1,8	1,1	0,5
C_Circ_Sol	central DHW system with solar thermal system and circulation	3,6	2,0	1,2

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4.10 Vent – Ventilation Systems

Table 47: Fraction of ventilation heat losses recovered by ventilation systems differentiated by country and by building size class (data source: Tab.System.Vent)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
Exh	SUH	min	0,0	0,0	-	0,6	0,0	0,0	-	-	0,0	-	-	-	0,0	-	0,0	0,0	-	0,0	0,7	-	0,1	-8%
		average	0,0	0,0	-	0,6	0,0	0,0	-	-	0,0	-	-	-	0,0	-	0,0	0,0	-	0,0	0,7	-	0,1	
		max	0,0	0,0	-	0,6	0,0	0,0	-	-	0,0	-	-	-	0,0	-	0,0	0,0	-	0,0	0,7	-	0,2	+41%
	MUH	min	0,0	0,0	-	0,6	0,0	0,0	0,0	-	0,0	-	-	-	-	-	0,0	0,0	-	0,0	0,7	-	0,1	-8%
		average	0,0	0,0	-	0,6	0,0	0,0	0,0	-	0,0	-	-	-	-	-	0,0	0,0	-	0,0	0,7	-	0,1	0%
		max	0,0	0,0	-	0,6	0,0	0,0	0,0	-	0,0	-	-	-	-	-	0,0	0,0	-	0,0	0,7	-	0,2	+41%
	deviation from "common"		-100%	-100%		+408%	-100%	-100%			-100%						-100%	-100%		-100%	+492%			
Bal	SUH	min	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,23	-33%
		average	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,35	
		max	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,47	+33%
	MUH	min	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,23	-33%
		average	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,35	0%
		max	-	-	-	0,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,7	-	0,47	+33%
	deviation from "common"					-100%															+100%			
Bal_Rec	SUH	min	0,6	0,8	-	-	0,6	0,6	0,6	-	0,6	0,9	0,5	0,8	0,9	0,8	1,0	0,5	0,6	0,8	-	0,8	0,69	-8%
		average	0,7	0,8	-	-	0,7	0,7	0,8	-	0,7	0,9	0,5	0,8	0,9	0,8	1,0	0,7	0,6	0,8	-	0,9	0,76	
		max	0,8	0,8	-	-	0,8	0,8	1,0	-	0,8	0,9	0,5	0,8	0,9	0,8	1,0	0,9	0,6	0,8	-	0,9	0,82	+8%
	MUH	min	0,6	0,8	-	-	0,6	0,6	0,6	-	0,6	0,9	0,5	0,8	0,9	0,8	1,0	0,5	0,6	0,8	-	0,8	0,69	-8%
		average	0,7	0,8	-	-	0,7	0,7	0,8	-	0,7	0,9	0,5	0,8	0,9	0,8	1,0	0,7	0,6	0,8	-	0,9	0,76	+0%
		max	0,8	0,8	-	-	0,8	0,8	0,9	-	0,8	0,9	0,5	0,8	0,9	0,8	1,0	0,9	0,6	0,8	-	0,9	0,81	+7%
	deviation from "common"		-8%	+6%			-5%	-8%	+1%		-8%	+19%	-34%	+6%	+20%	+6%	+25%	-10%	-27%	+6%		+12%		
Bal_GroundRec	SUH	min	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	0%
		average	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	
		max	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	0%
	MUH	min	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	0%
		average	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	0%
		max	-	-	-	-	-	0,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90	0%
	deviation from "common"							0%																

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Table 48: Annual auxiliary electricity demand of ventilation systems differentiated by country and by building size class (data source: Tab.System.Vent)

			AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation
Exh	SUH	min	1,1	1,2	-	2,0	1,1	1,1	-	-	0,9	-	-	-	1,4	-	2,4	0,7	-	1,5	2,0	-	1,3	-17%
		average	1,1	2,4	-	2,0	1,1	1,1	-	-	1,5	-	-	-	1,4	-	3,0	0,7	-	1,5	2,0	-	1,6	
		max	1,1	3,5	-	2,0	1,1	1,1	-	-	2,6	-	-	-	1,4	-	3,5	0,7	-	1,5	2,0	-	2,0	+24%
	MUH	min	1,1	1,2	-	2,0	1,1	1,1	7,6	-	1,4	-	-	-	-	-	2,4	0,7	-	1,5	2,0	-	1,9	-15%
		average	1,1	2,4	-	2,0	1,1	1,1	7,6	-	2,1	-	-	-	-	-	3,0	0,7	-	1,5	2,0	-	2,2	+38%
		max	1,1	3,5	-	2,0	1,1	1,1	7,6	-	3,3	-	-	-	-	-	3,5	0,7	-	1,5	2,0	-	2,9	+31%
	deviation from "common"		-43%	+22%		+4%	-43%	-43%			-6%						+54%	-64%		-22%	+4%			
Bal	SUH	min	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,36	-7%
		average	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,53	
		max	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,71	+7%
	MUH	min	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,36	-7%
		average	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,53	0%
		max	-	-	-	3,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	-	2,71	+7%
	deviation from "common"					+21%															-21%			
Bal_Rec	SUH	min	1,7	2,7	-	-	2,1	1,7	3,0	-	3,1	2,0	4,6	2,6	2,1	1,4	4,2	3,0	1,8	2,4	-	2,0	2,46	-14%
		average	2,2	2,7	-	-	2,3	2,2	3,8	-	3,5	2,0	4,6	2,6	2,4	1,4	5,4	4,3	1,8	2,4	-	2,0	2,85	
		max	2,6	2,7	-	-	2,5	2,6	4,6	-	3,9	2,0	4,6	2,6	2,8	1,4	6,6	5,0	1,8	2,4	-	2,0	3,33	+17%
	MUH	min	1,7	2,7	-	-	2,1	1,7	4,6	-	3,1	2,0	4,6	2,6	2,0	1,4	4,2	4,0	1,8	2,4	-	2,0	2,60	-16%
		average	2,2	2,7	-	-	2,4	2,2	6,1	-	3,7	2,0	4,6	2,6	2,4	1,4	5,4	6,0	1,8	2,4	-	2,0	3,11	+9%
		max	2,6	2,7	-	-	2,5	2,6	7,6	-	4,4	2,0	4,6	2,6	2,8	1,4	6,6	7,0	1,8	2,4	-	2,0	3,71	+19%
	deviation from "common"		-28%	-9%			-22%	-28%	+66%		+21%	-33%	+55%	-13%	-19%	-52%	+81%	+74%	-41%	-19%		-33%		
Bal_GroundRec	SUH	min	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	0%
		average	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	
		max	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	0%
	MUH	min	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	0%
		average	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	0%
		max	-	-	-	-	-	2,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,60	0%
	deviation from "common"							0%																

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Table 49: Deviations from averages ("common values") per country – recovered heat loss fraction

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
Exh	-100%	-100%		+408%	-100%	-100%			-100%						-100%	-100%		-100%	+492%	
Bal				-100%															+100%	
Bal_Rec	-8%	+6%			-5%	-8%	+1%		-8%	+19%	-34%	+6%	+20%	+6%	+25%	-10%	-27%	+6%		+12%
Bal_GroundRec						0%														

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Table 50: Deviations from averages ("common values") per country – auxiliary energy demand

	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI
Exh	-43%	+22%		+4%	-43%	-43%			-6%						+54%	-64%		-22%	+4%	
Bal				+21%															-21%	
Bal_Rec	-28%	-9%			-22%	-28%	+66%		+21%	-33%	+55%	-13%	-19%	-52%	+81%	+74%	-41%	-19%		-33%
Bal_GroundRec						0%														

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Table 51: Fraction of ventilation heat losses recovered by ventilation systems /merged and condensed values (data source: Tab.System.Vent)

ventilation system type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
Exh	exhaust air system	poor	0,00	0,00		0,60	0,00	0,00	0,00		0,00				0,00		0,00	0,00		0,00	0,70		0,05	-50%
		medium	0,00	0,00		0,60	0,00	0,00	0,00		0,00				0,00		0,00	0,00		0,00	0,70		0,11	
		high	0,00	0,00		0,60	0,00	0,00	0,00		0,00				0,00		0,00	0,00		0,00	0,70		0,40	+273%
	consideration in "common"		1	1		1	1	1	1		1				1		1	1		1	1		n=12	
Bal	balanced ventilation system	poor				0,00															0,70		0,18	-50%
		medium				0,00															0,70		0,35	
		high				0,00															0,70		0,53	+50%
	consideration in "common"					1															1		n=2	
Bal_Rec	balanced ventilation system with heat recovery	poor	0,60	0,80			0,60	0,60	0,60		0,60	0,90	0,50	0,80	0,90	0,80	0,95	0,50	0,55	0,80		0,80	0,60	-20%
		medium	0,70	0,80			0,72	0,70	0,76		0,70	0,90	0,50	0,80	0,91	0,80	0,95	0,68	0,55	0,80		0,85	0,76	
		high	0,80	0,80			0,80	0,80	0,90		0,80	0,90	0,50	0,80	0,92	0,80	0,95	0,85	0,55	0,80		0,90	0,88	+16%
	consideration in "common"		1	1			1	1	1		1	1	1	1	1	1	1	1	1	1		1	n=16	
Bal_GroundRec	balanced ventilation system, preheated by ground heat exchanger + heat recovery	poor						0,90															0,90	0%
		medium						0,90															0,90	
		high						0,90															0,90	0%
	consideration in "common"							1															n=1	

Remarks

10-04-2015

Determination of common values

Exh + Bal: FR + SE: not considered since values > 0 are not plausible

Table 52: Annual auxiliary electricity demand of ventilation systems / merged and condensed values (data source: Tab.System.Vent)

ventilation system type		energy efficiency	AT	BE	BG	CY	CZ	DE	DK	ES	FR	GB	GR	HU	IE	IT	NL	NO	PL	RS	SE	SI	common	deviation from medium
Exh	exhaust air system	poor	1,1	3,5		2,0	1,1	1,1	7,6		3,3				1,4		3,5	0,7		1,5	2,0		5,0	+134%
		medium	1,1	2,4		2,0	1,1	1,1	7,6		1,8				1,4		3,0	0,7		1,5	2,0		2,1	
		high	1,1	1,2		2,0	1,1	1,1	7,6		0,9				1,4		2,4	0,7		1,5	2,0		1,3	-39%
	consideration in "common"		1	1		1	1	1	1		1				1		1	1		1	1		n=12	
Bal	balanced ventilation system	poor				3,1															2,0		2,8	+11%
		medium				3,1															2,0		2,5	
		high				3,1															2,0		2,3	-11%
	consideration in "common"					1															1		n=2	
Bal_Rec	balanced ventilation system with heat recovery	poor	2,6	2,7			2,5	2,6	7,6		4,4	2,0	4,6	2,6	2,8	1,4	6,6	7,0	1,8	2,4		2,0	5,5	+86%
		medium	2,2	2,7			2,3	2,2	4,9		3,6	2,0	4,6	2,6	2,4	1,4	5,4	5,2	1,8	2,4		2,0	3,0	
		high	1,7	2,7			2,1	1,7	3,0		3,1	2,0	4,6	2,6	2,0	1,4	4,2	3,0	1,8	2,4		2,0	2,0	-34%
	consideration in "common"		1	1			1	1	1		1	1	1	1	1	1	1	1	1	1		1	n=16	
Bal_GroundRec	balanced ventilation system, preheated by ground heat exchanger + heat recovery	poor						2,6															2,6	0%
		medium						2,6															2,6	
		high						2,6															2,6	0%
	consideration in "common"							1															n=1	

Remarks

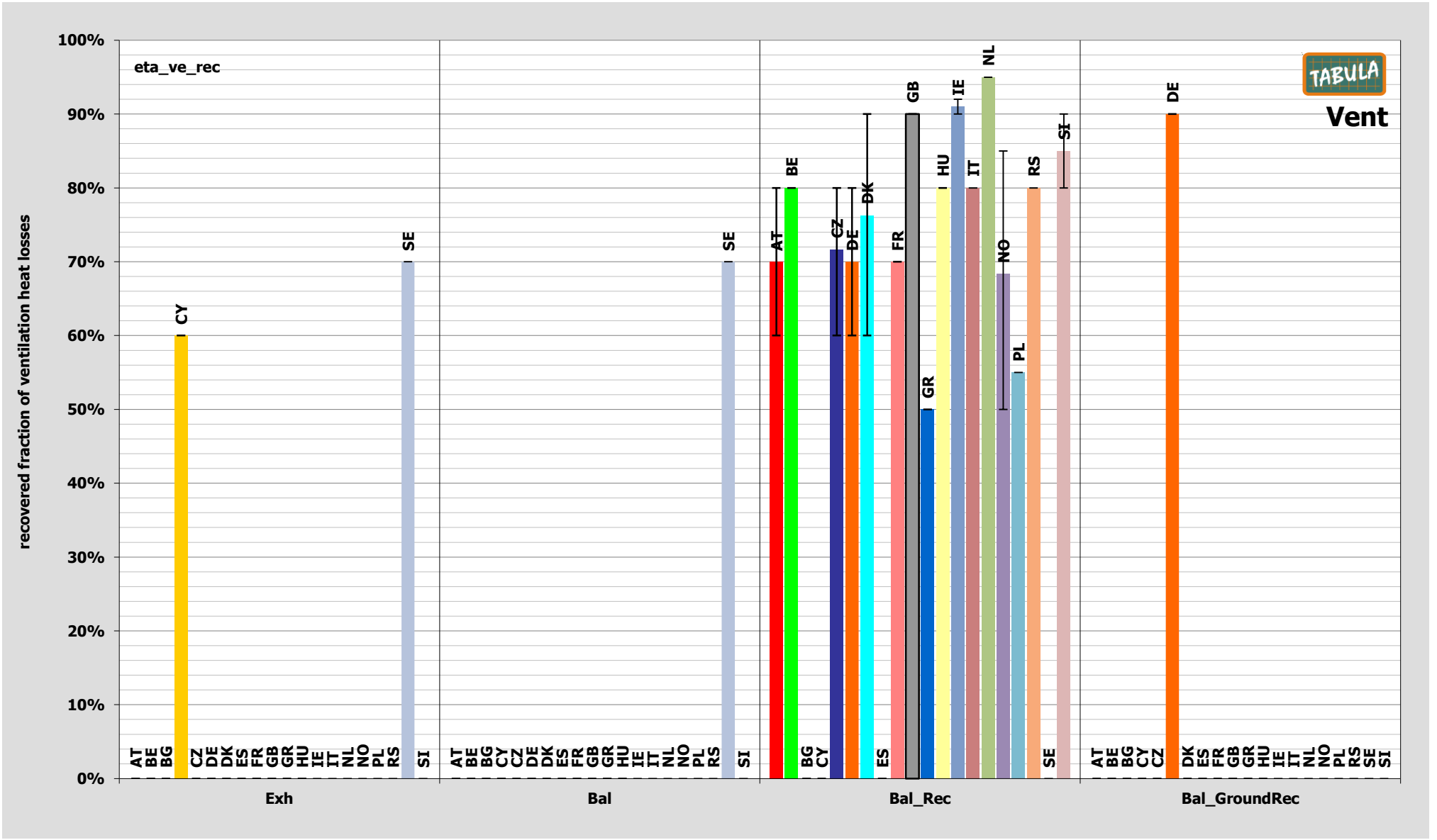
10-04-2015

Determination of common values

Exh DK: not considered (not plausible: values larger than / equal to balanced ventilation with heat recovery)

Figure 27: **Recovered fraction of ventilation heat losses + annual auxiliary energy demand of ventilation systems**

<Exh> exhaust air system; <Bal> balanced ventilation system; <Bal_Rec> balanced ventilation system with heat recovery; <Bal_GroundRec> balanced ventilation system, preheated by ground heat exchanger + heat recovery



10-04-2015

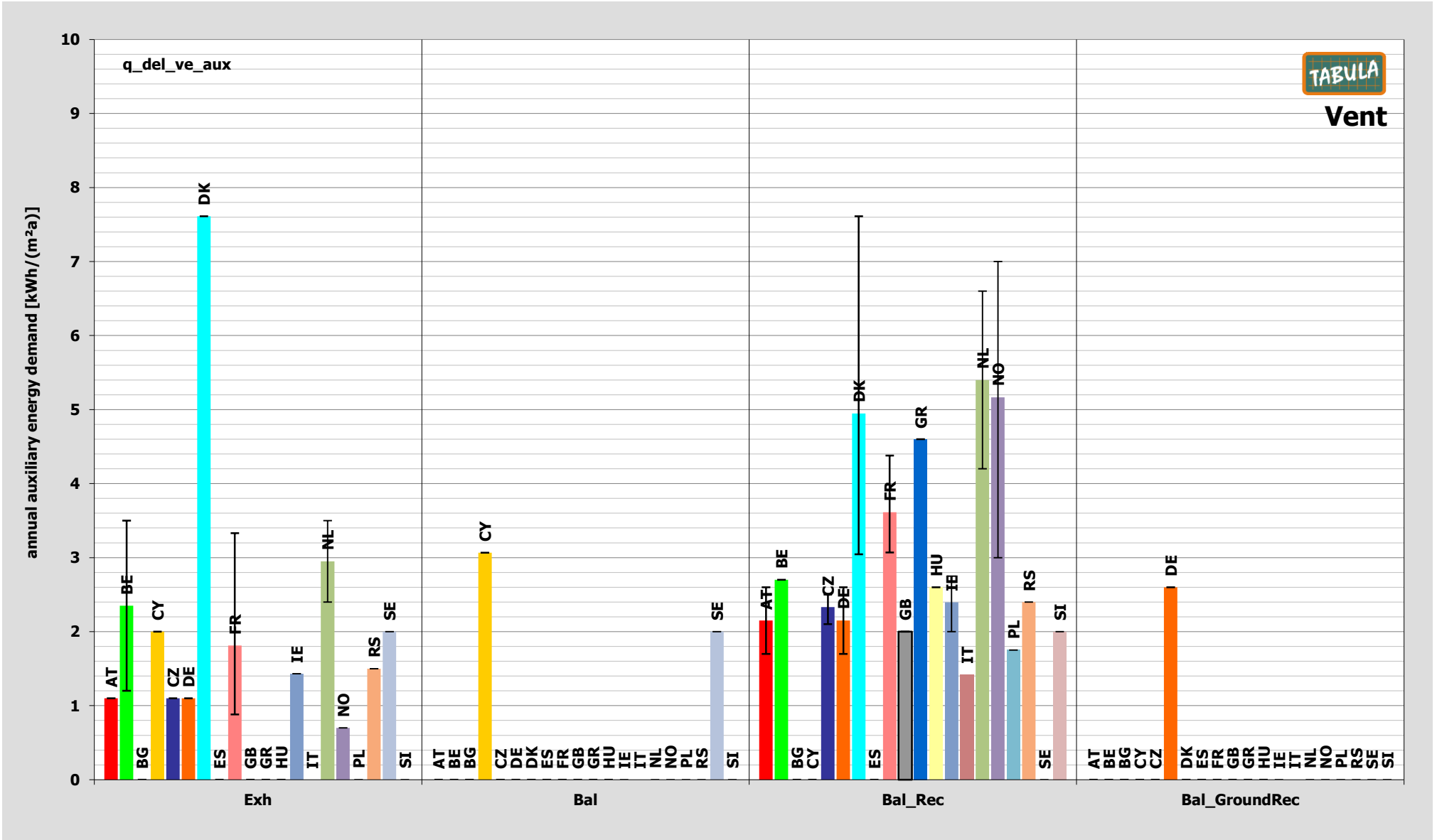

q_del_ve_aux
TABULA
Vent
annual auxiliary energy demand [kWh/(m²a)]
10
9
8
7
6
5
4
3
2
1
0
Exh
Bal
Bal_Rec
Bal_GroundRec
AT
BE
BG
CY
CZ
DE
DK
ES
FR
GB
GR
HU
IE
IT
NL
NO
PL
RS
SE
SI

Table 53: Performance of ventilation systems / derived default values (simplified common values)

TABULA code	description	heat recovery by ventilation systems			auxiliary energy demand (electricity) of ventilation systems		
		overall performance ratio of heat recovery by the heat exchanger			annual values in kWh per m² reference area		
		$\eta_{ve,rec}$			$q_{del,ve,aux}$		
		[-]			[kWh/(m²a)]		
	energy efficiency	**poor**	**standard**	**high**	**poor**	**standard**	**high**
Exh	exhaust air system	0,05	0,11	0,40	5,0	2,1	1,3
Bal	balanced ventilation system	0,18	0,35	0,53	2,8	2,5	2,3
Bal_Rec	balanced ventilation system with heat recovery	0,60	0,76	0,88	5,5	3,0	2,0
Bal_GroundRec	balanced ventilation system, preheated by ground heat exchanger + heat recovery	0,90	0,90	0,90	2,6	2,6	2,6

10-04-2015

5 Résumé

The evaluation of the TABULA database provided a number of important insights and findings and will be the basis for a further development in different directions:

- **Feedback of data input**

  The comparison with other countries gives indications of unclear definitions or data input errors. This may prompt TABULA partners to check and maybe revise their input or to provide supplemental data.

- **Means for introducing and improving the quality assurance**

  The analysis of the variation of the quantities enables the definition and assignment of plausibility limits. These can in the future be used for an introduction of quality assurance procedures which enable an immediate control of plausibility in the phase of data entering.

  These QA mechanisms can of course also serve for plausibility controls on national level (e.g. during EPC issuing).

- **Selection of measures for Refurbishment Packages 1 and 2:**

  The rules for the definition of refurbishment packages on the two levels are until now rather vague (RP1 / Standard: "commonly realised during renovation"; RP2 / Advanced: "usually only realised in very ambitious renovations or research projects"). However, a cross-country comparison and discussion of energy upgrade quality is a very important task for the future.

- **Utilisation of the averages / default values for simplified assessment of building portfolios and stocks:**

  The analyses of the TABULA database delivered a number of average or default values for envelope and supply system components as well as dependencies of the thermal envelope area on certain basic parameters. Apart from quality assurance procedures these findings also offer the possibility of a simplified assessment of housing portfolios and stocks. The data acquisition would be reduced to the following intake quantities:

  - Thermal envelope area: living space, number of storeys, number of attached neighbour buildings, utilisation state of attic and cellar;
  - U-values: construction year (class), structure type, type of windows, later applied insulation measures (insulation thickness and renovated area fraction);
  - Supply system: type of energy carrier, heat generator, storage, distribution (for space heating and dhw).

  Starting from these data energy balance calculations can be performed that deliver a rough estimate of the energy quality of the housing portfolio or stock and (in case the typical relation of measured and calculated consumption is known) also an estimation value of the energy consumption by energy carrier. Vice versa, if the measured consumption is known for a specific building the above mentioned intake quantities will enable an allocation of the actual heat losses and an estimation of the possible energy savings by distinct measures (recommendations for operational rating).

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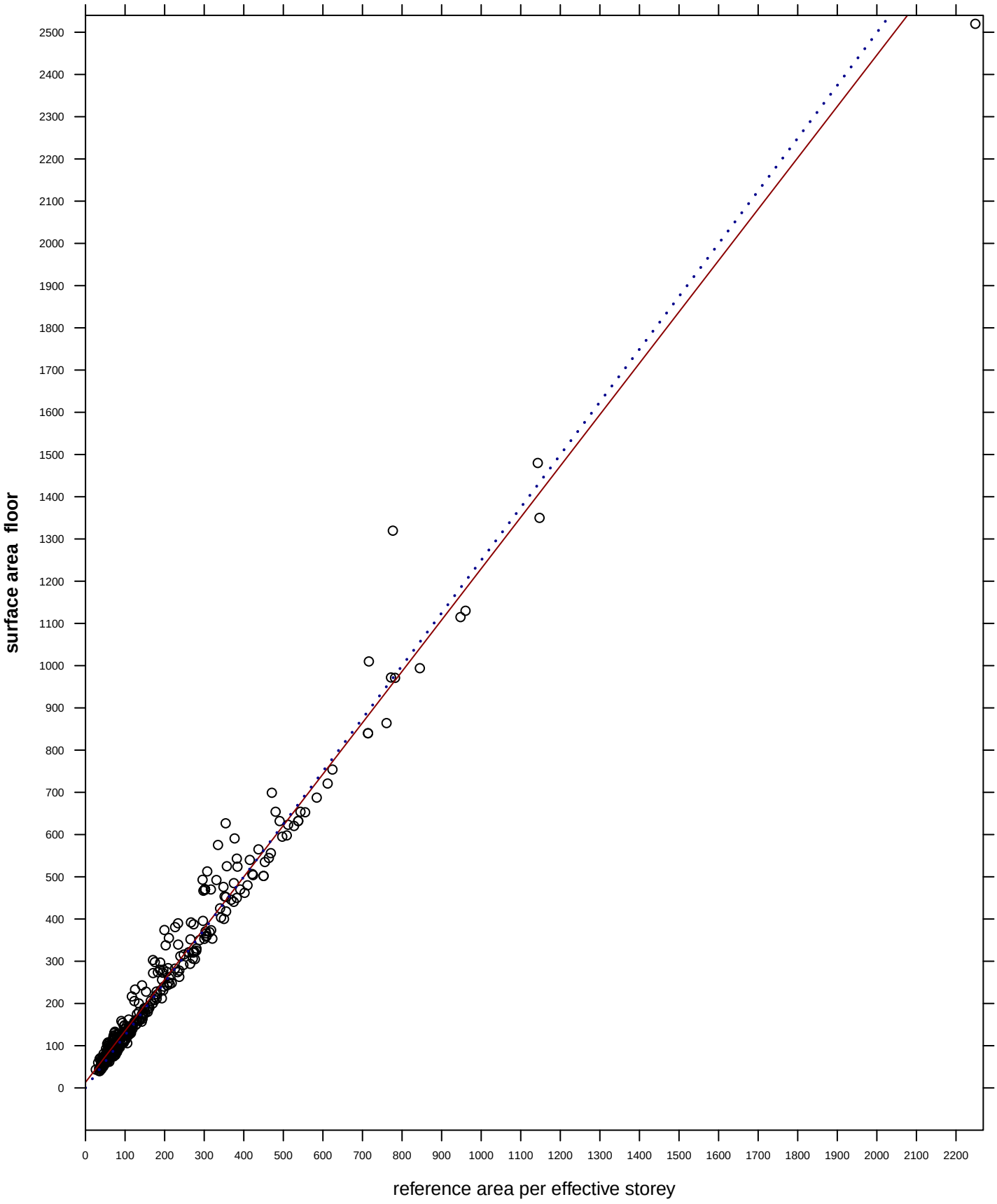
www.building-typology.eu/downloads/public/docs/report/TABULA_TR2_D8_NationalEnergyBalances.pdf

[TABULA CalcProc 2013] Loga, Tobias; Diefenbach, Nikolaus: TABULA Calculation Method – Energy Use for Heating and Domestic Hot Water. Reference Calculation and Adaptation to the Typical Level of Measured Consumption; TABULA documentation; IWU, Darmstadt / Germany – January 2013 (ISBN 978-3-941140-31-8 / 56 pages)
www.building-typology.eu/downloads/public/docs/report/TABULA_CommonCalculationMethod.pdf

Appendix – Thermal Envelope Area Analysis Report

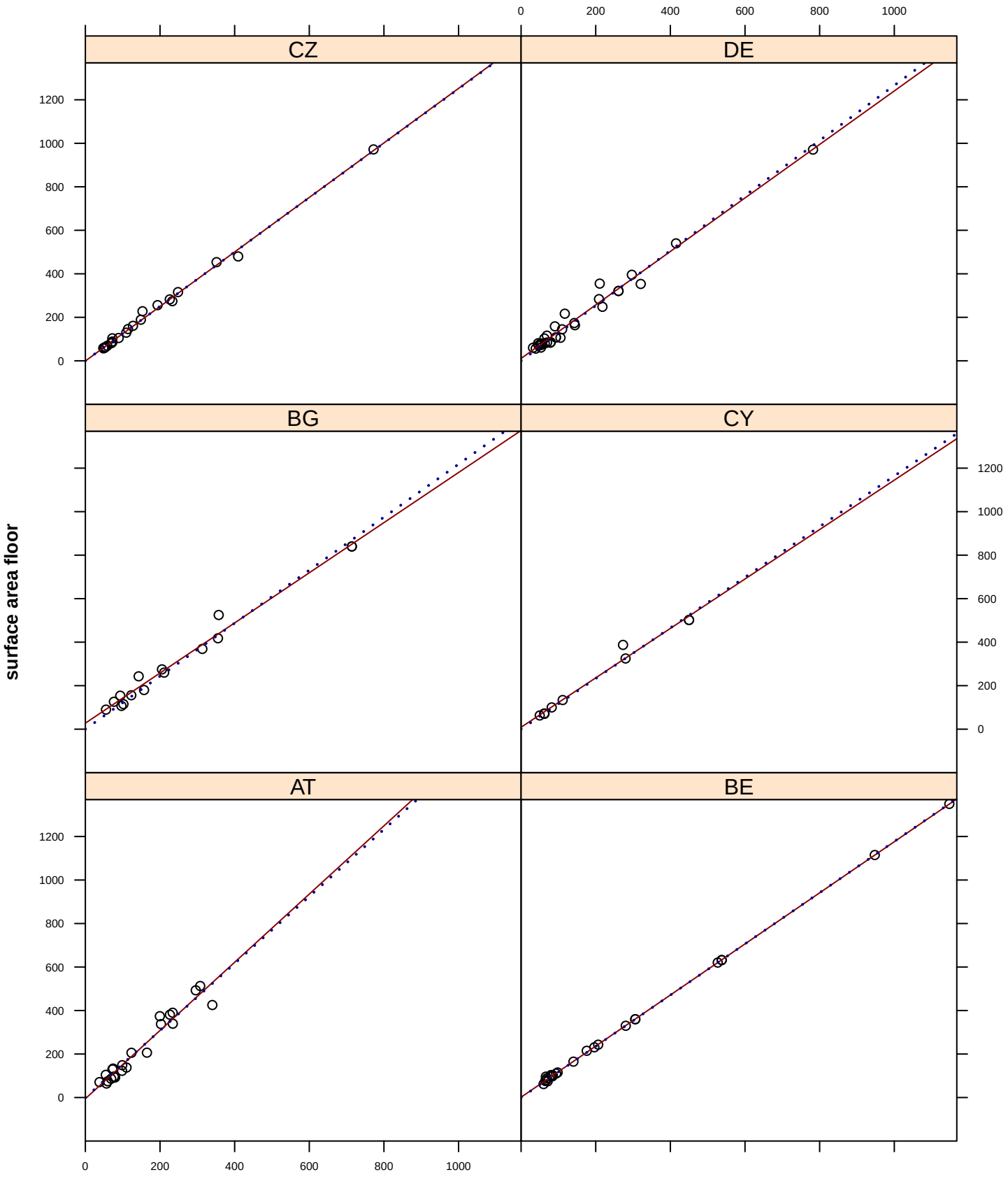
surface area floor ~ reference area per effective storey (n= 426)

R^2 = 0.97 ,b = 13.3 , m = 1.21



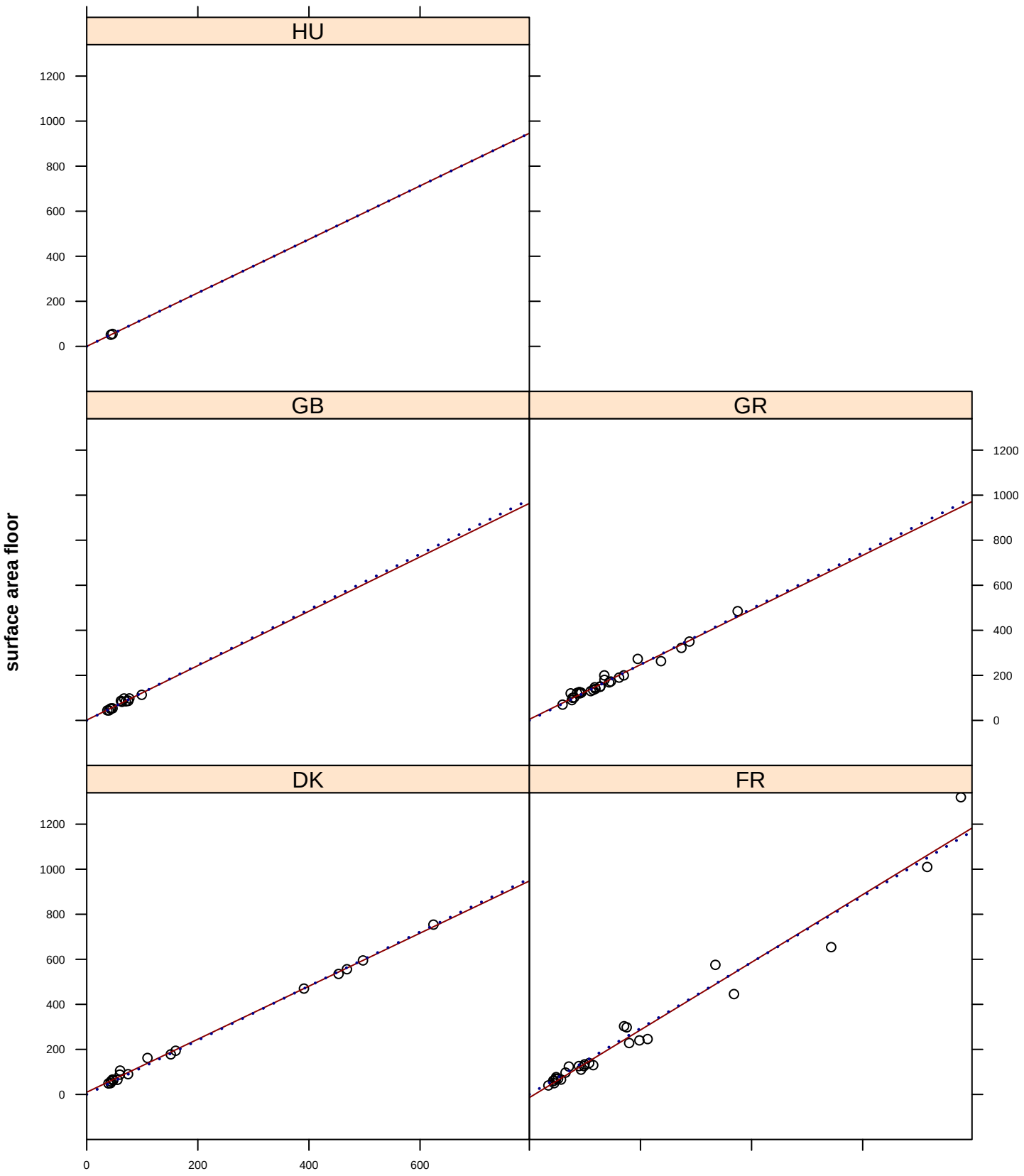
(Dotted = zero crossing: R^2 = 0.98 , m = 1.24)

surface area floor ~ reference area per effective storey
by countries I

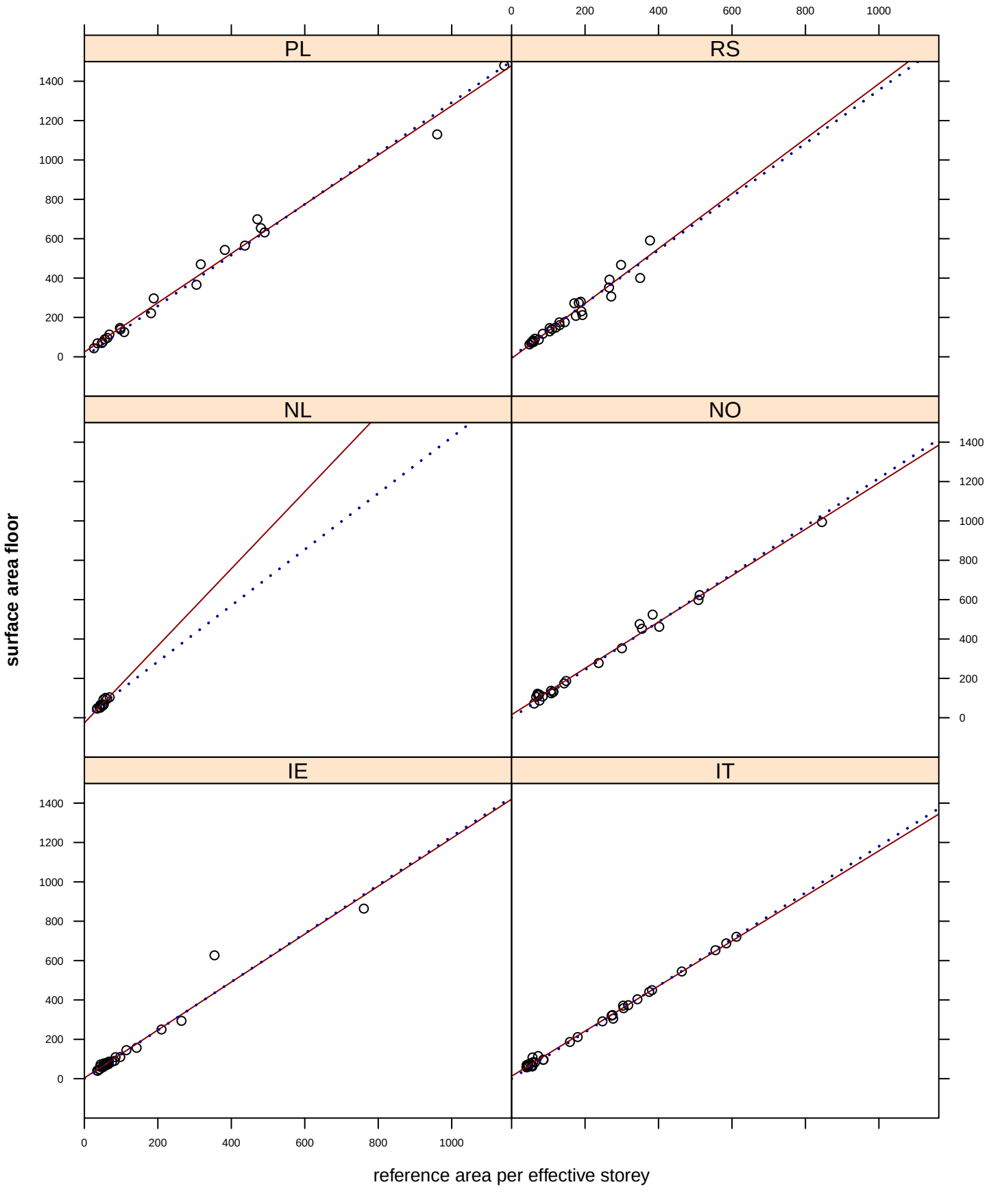


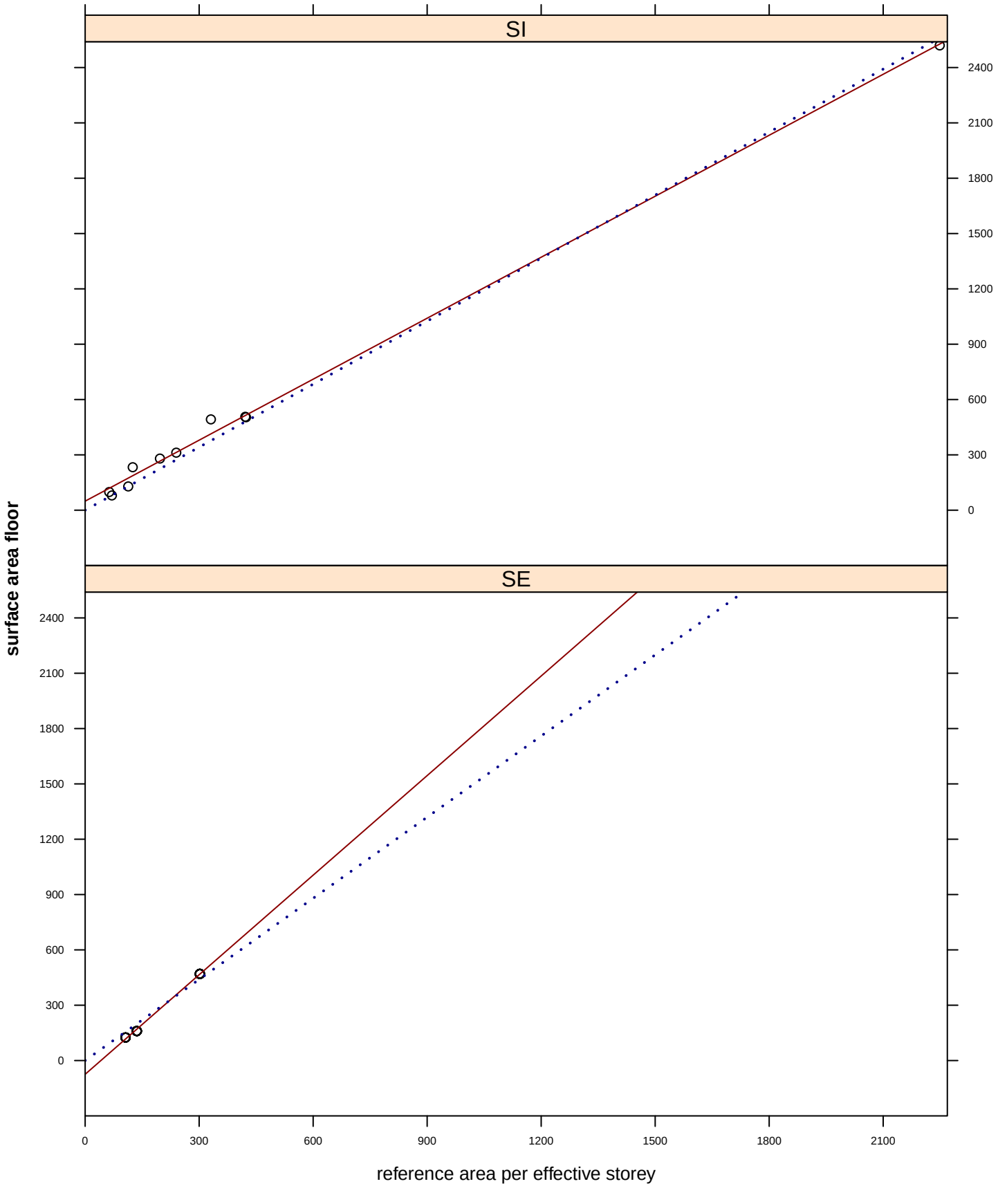
Dotted: With zero crossing

surface area floor ~ reference area per effective storey
by countries II

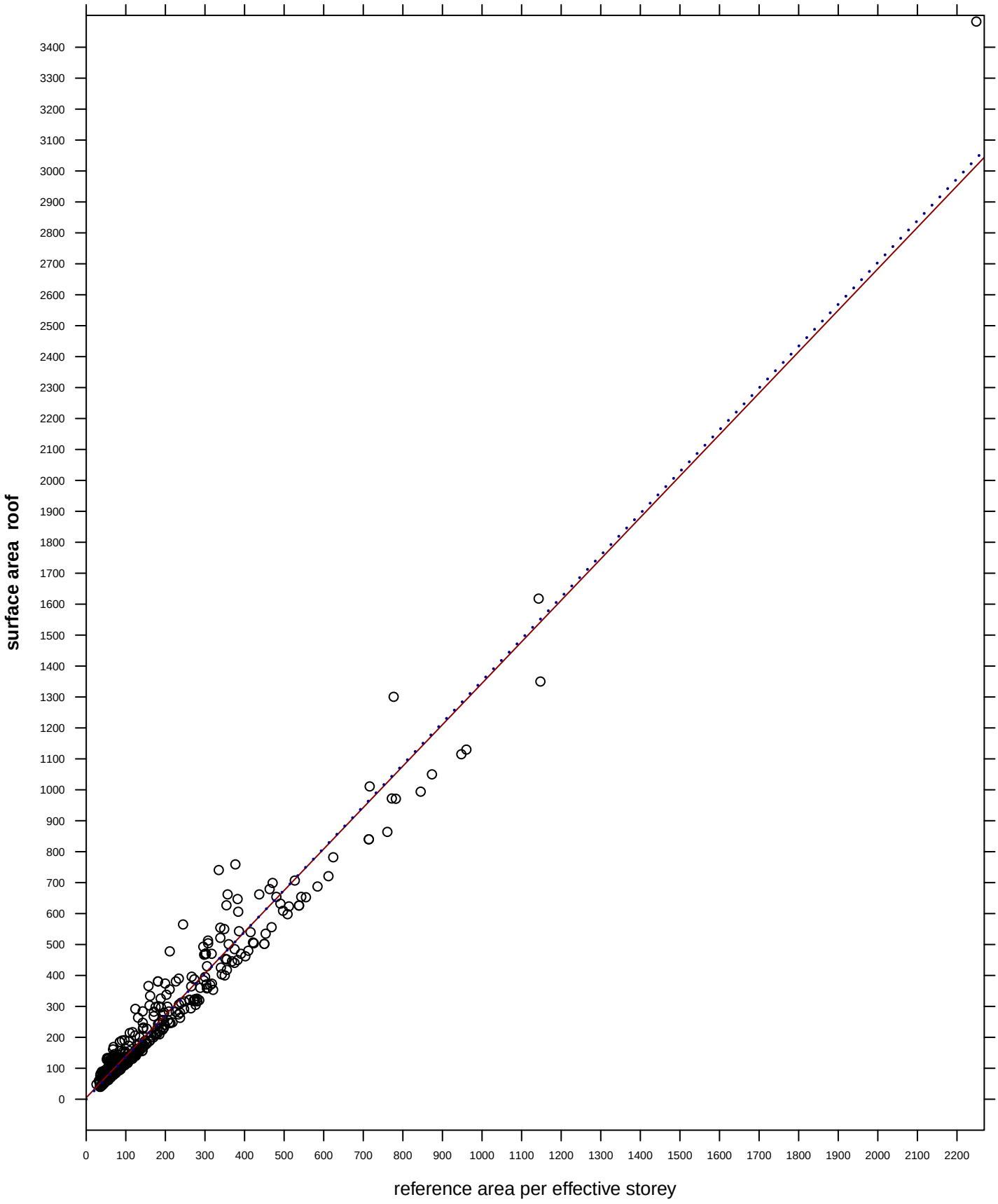


Dotted: With zero crossing

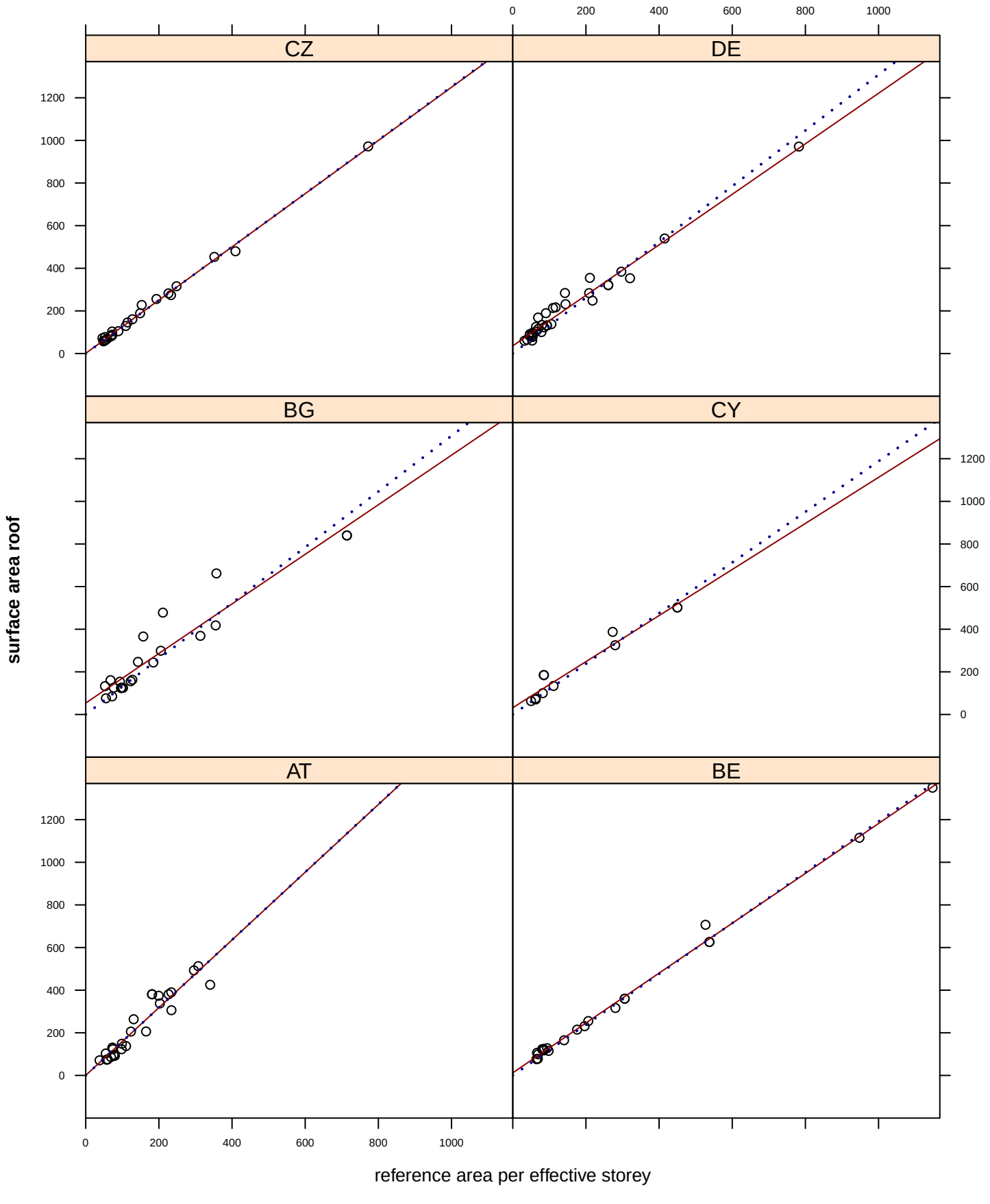

surface area floor ~ reference area per effective storey
by countries III
PL
RS
NL
NO
IE
IT
surface area floor
reference area per effective storey
0
200
400
600
800
1000
1200
1400
Dotted: With zero crossing


surface area floor ~ reference area per effective storey
by countries IV
SI
SE
surface area floor
reference area per effective storey
0
300
600
900
1200
1500
1800
2100
2400
Dotted: With zero crossing

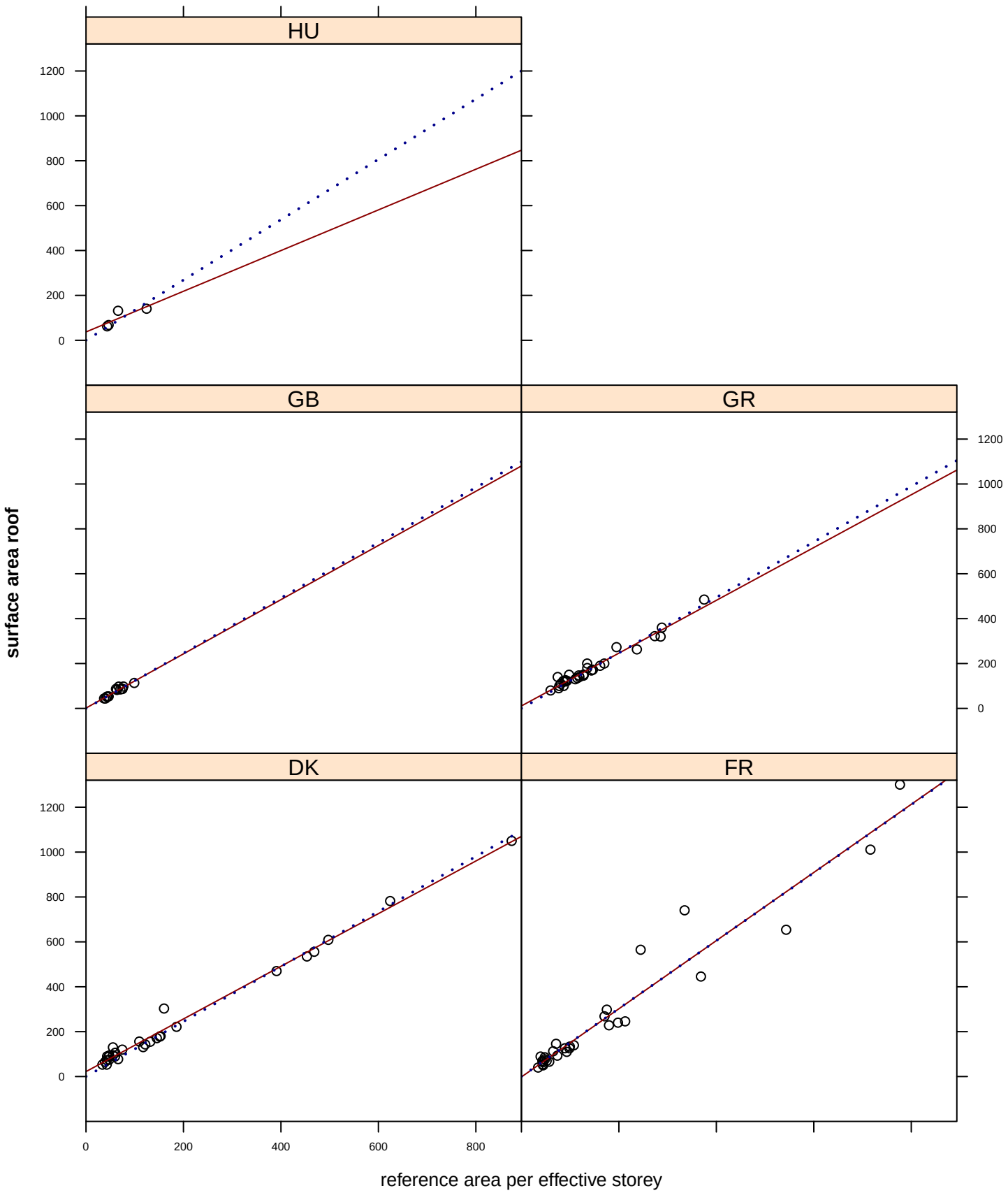
surface area roof ~ reference area per effective storey (n= 472)
R^2 = 0.95 ,b = 5.01 , m = 1.33



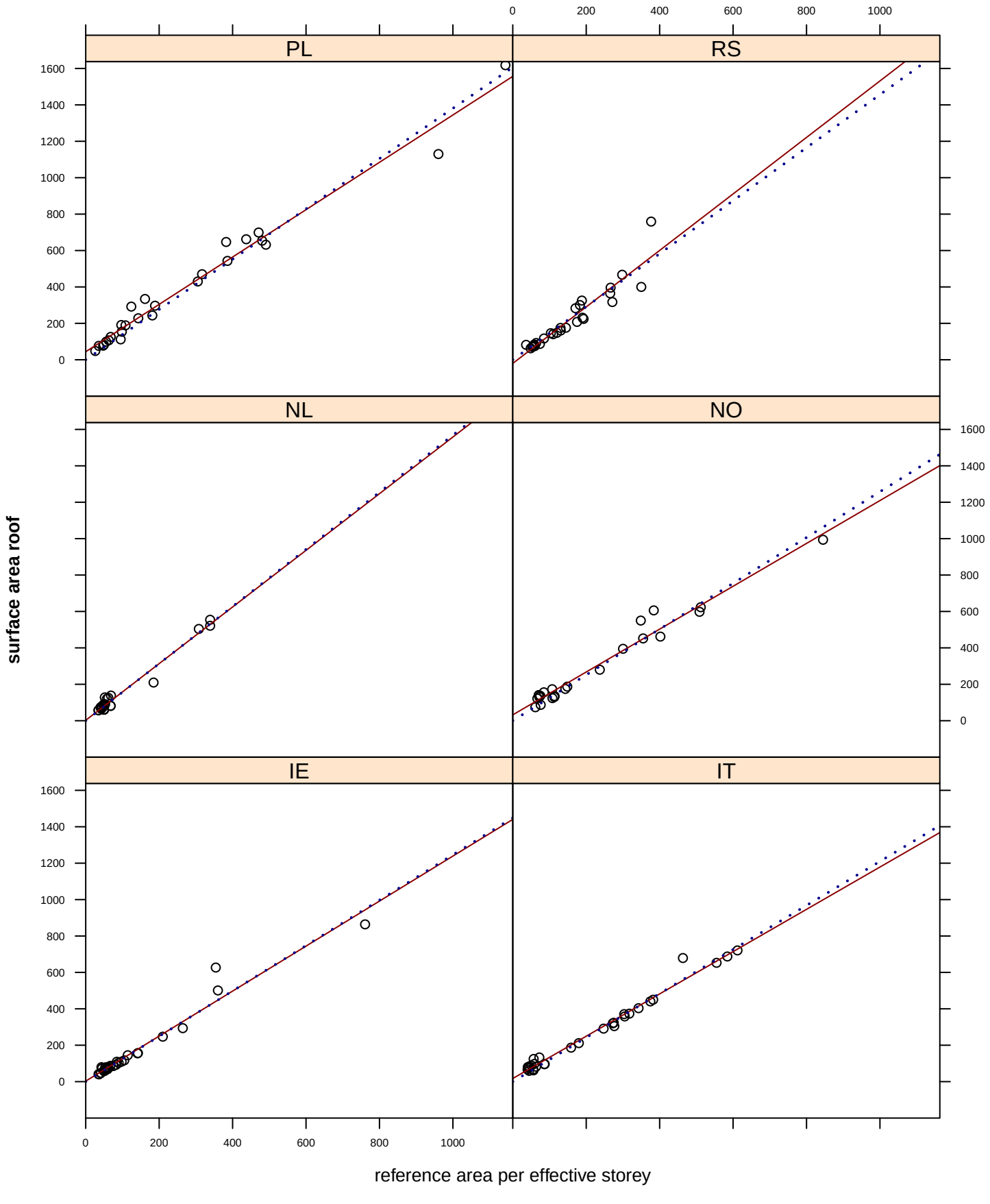
(Dotted = zero crossing: R^2 = 0.97 , m = 1.35)


surface area roof ~ reference area per effective storey
by countries I
CZ
DE
BG
CY
AT
BE
surface area roof
reference area per effective storey
0
200
400
600
800
1000
1200
Dotted: With zero crossing

surface area roof ~ reference area per effective storey
by countries II



Dotted: With zero crossing


surface area roof ~ reference area per effective storey
by countries III
PL
RS
NL
NO
IE
IT
surface area roof
reference area per effective storey
0
200
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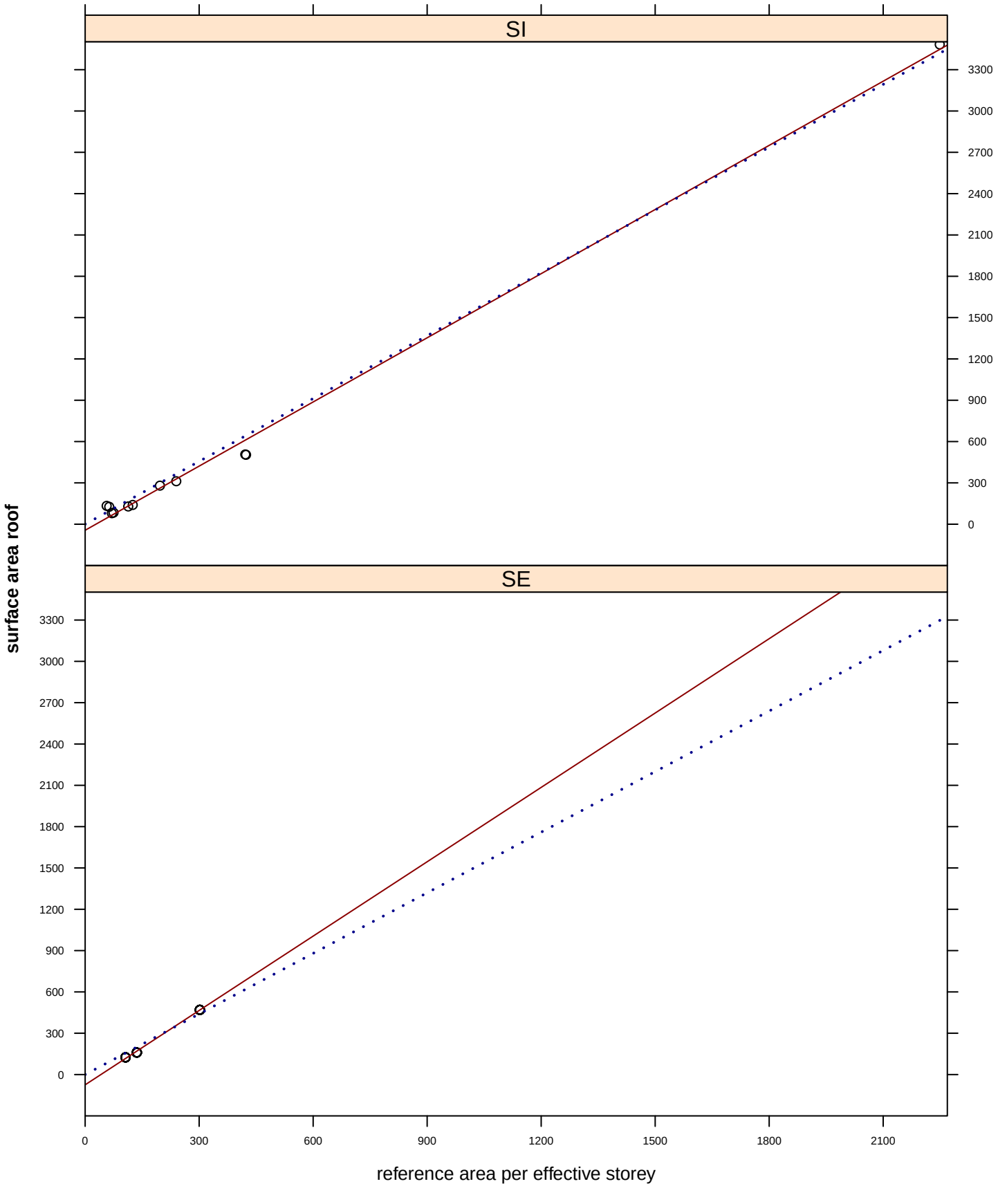
600
800
1000
1200
1400
1600
Dotted: With zero crossing


surface area roof ~ reference area per effective storey
by countries IV
SI
SE
surface area roof
reference area per effective storey
0
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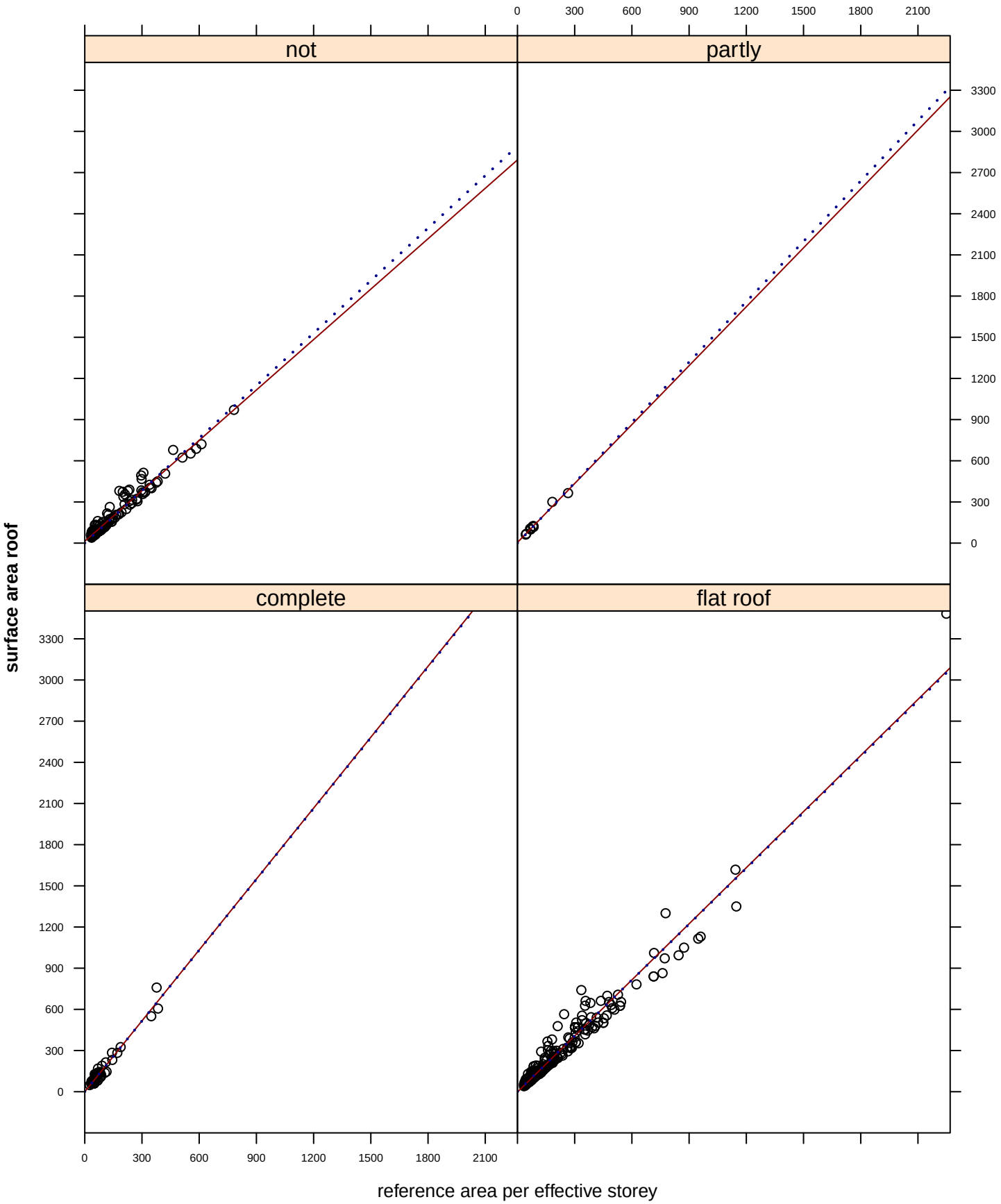
2100
2400
2700
3000
3300
Dotted: With zero crossing

surface area roof ~ reference area per effective storey
by attic conditioned



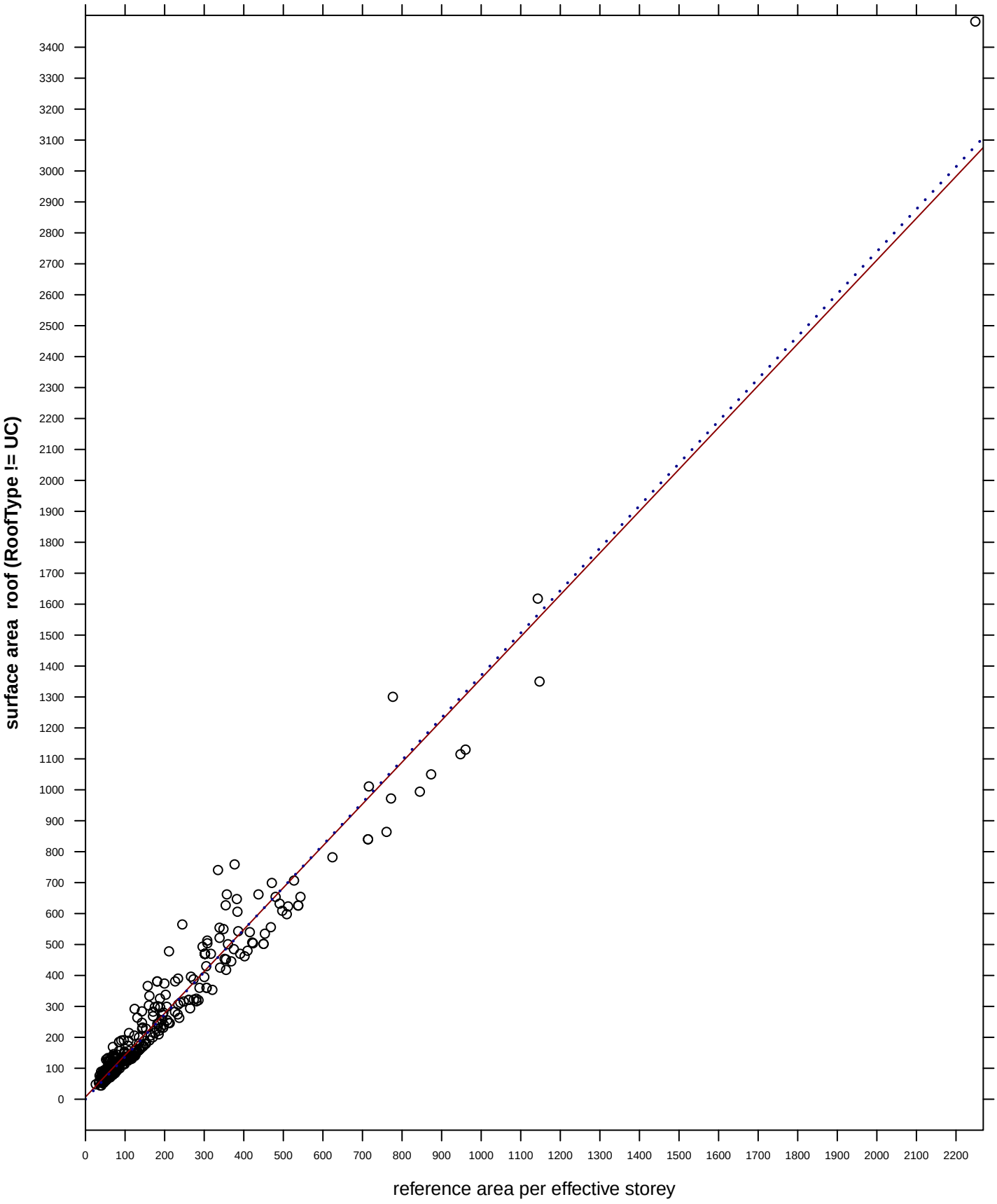
Dotted: With zero crossing

Intercept, slope and R^2, slope and R^2 at zerocrossing

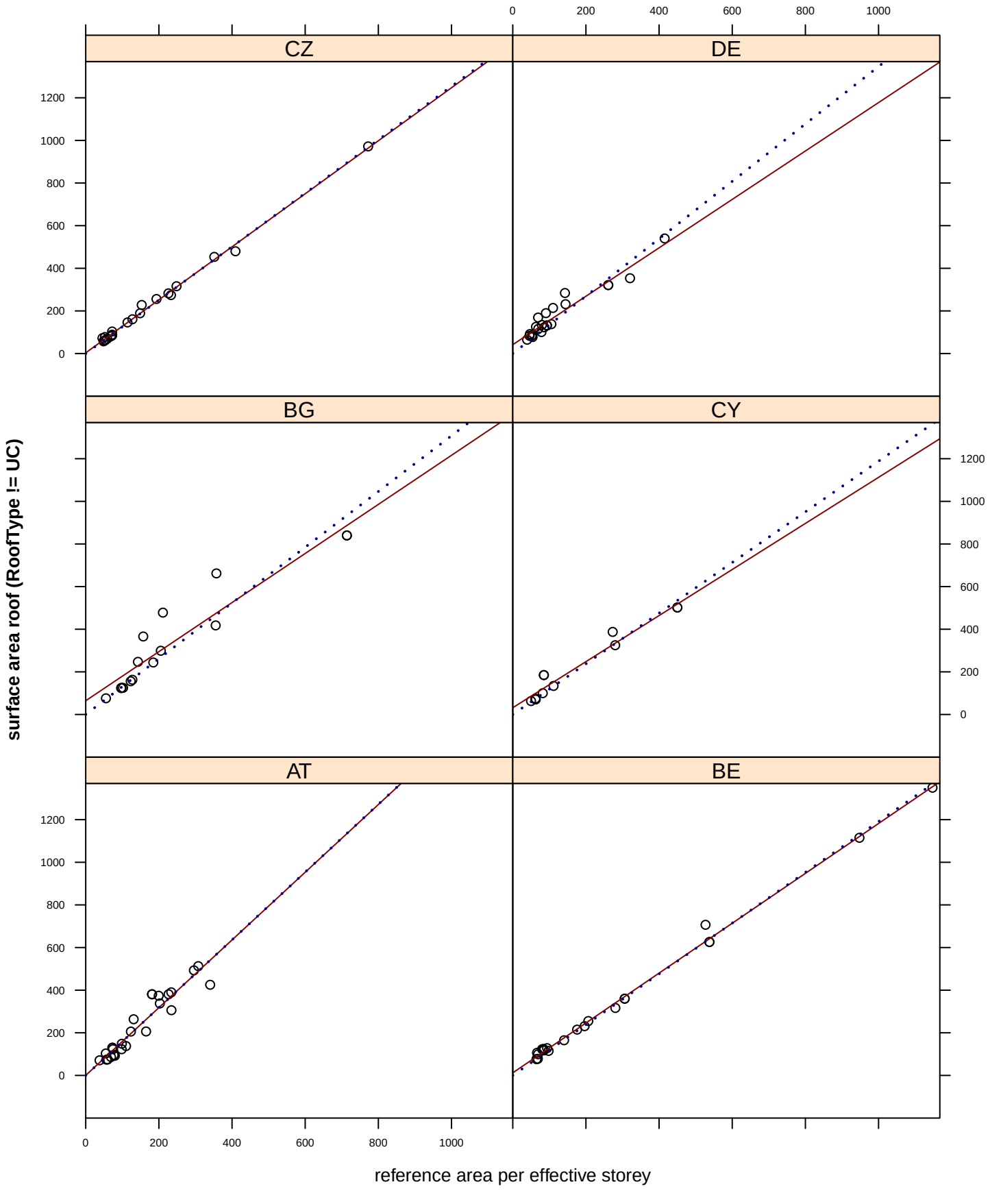
surface area roof ~ reference area per effective storey
by attic conditioned

	b	m	R^2	0_m	0_R^2	n
A_Roof: not conditioned	13.617	1.225	0.953	1.275	0.979	133
A_Roof: partly conditioned	5.007	1.431	0.981	1.466	0.994	10
A_Roof: completely conditioned	−0.417	1.722	0.959	1.719	0.981	71
A_Roof: flat roof	−2.665	1.362	0.958	1.357	0.977	258

surface area roof (RoofType != UC) ~ reference area per effective storey (n= 369)
R^2 = 0.95 ,b = 7.26 , m = 1.35



(Dotted = zero crossing: R^2 = 0.97 , m = 1.36)


surface area roof (RoofType != UC) ~ reference area per effective storey
by countries I
CZ
DE
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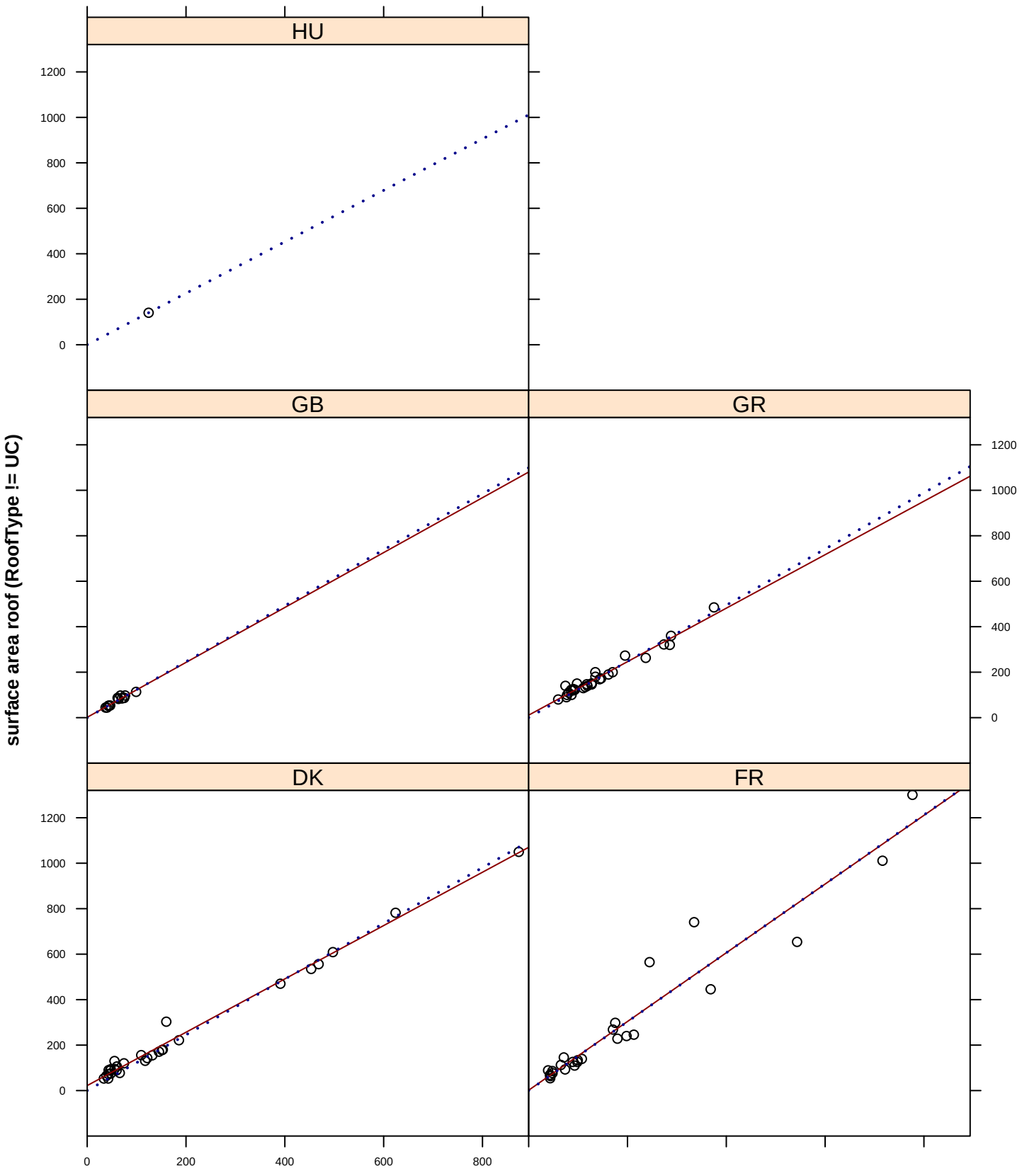
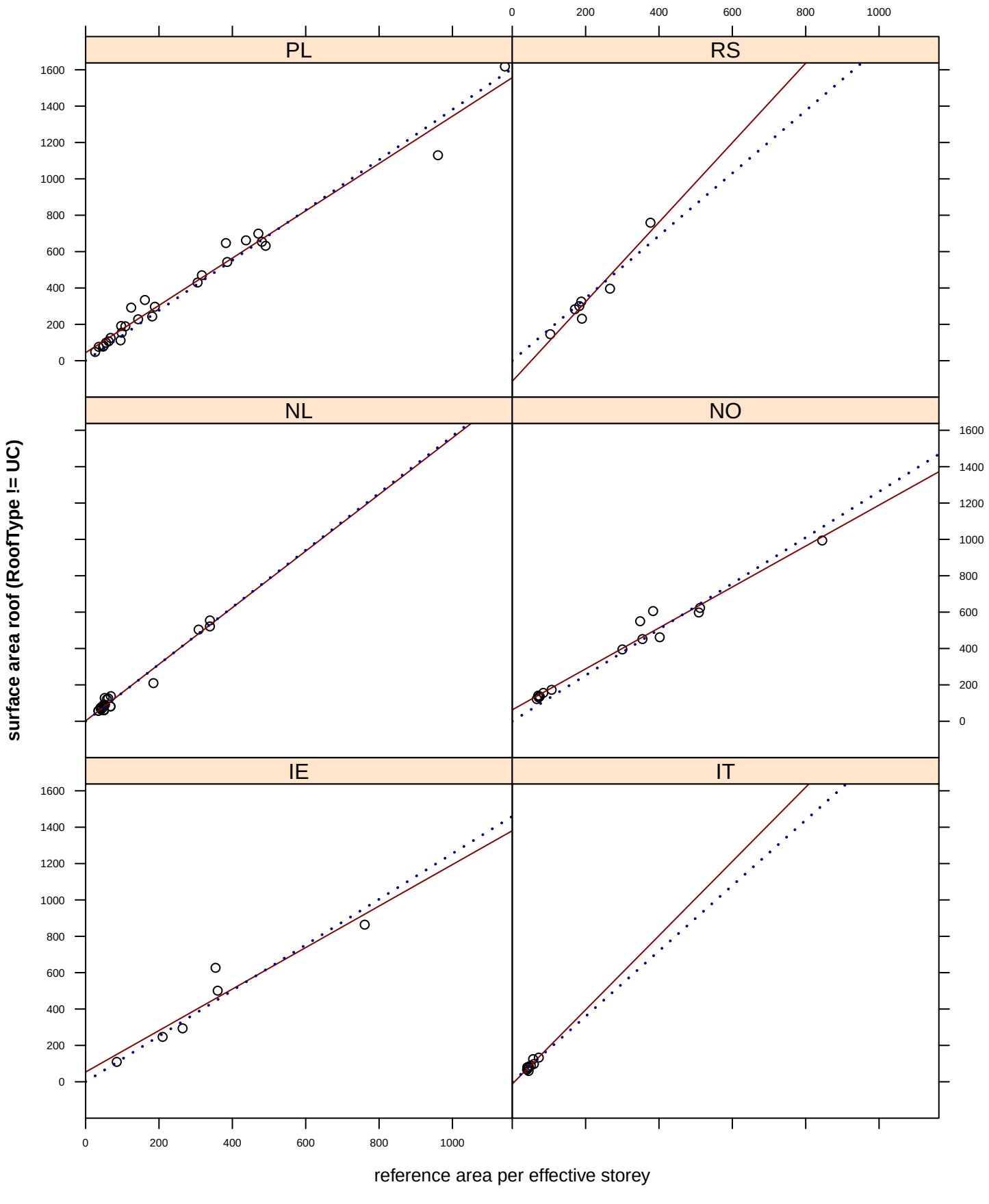
AT
BE
surface area roof (RoofType != UC)
reference area per effective storey
0
200
400
600
800
1000
1200
Dotted: With zero crossing

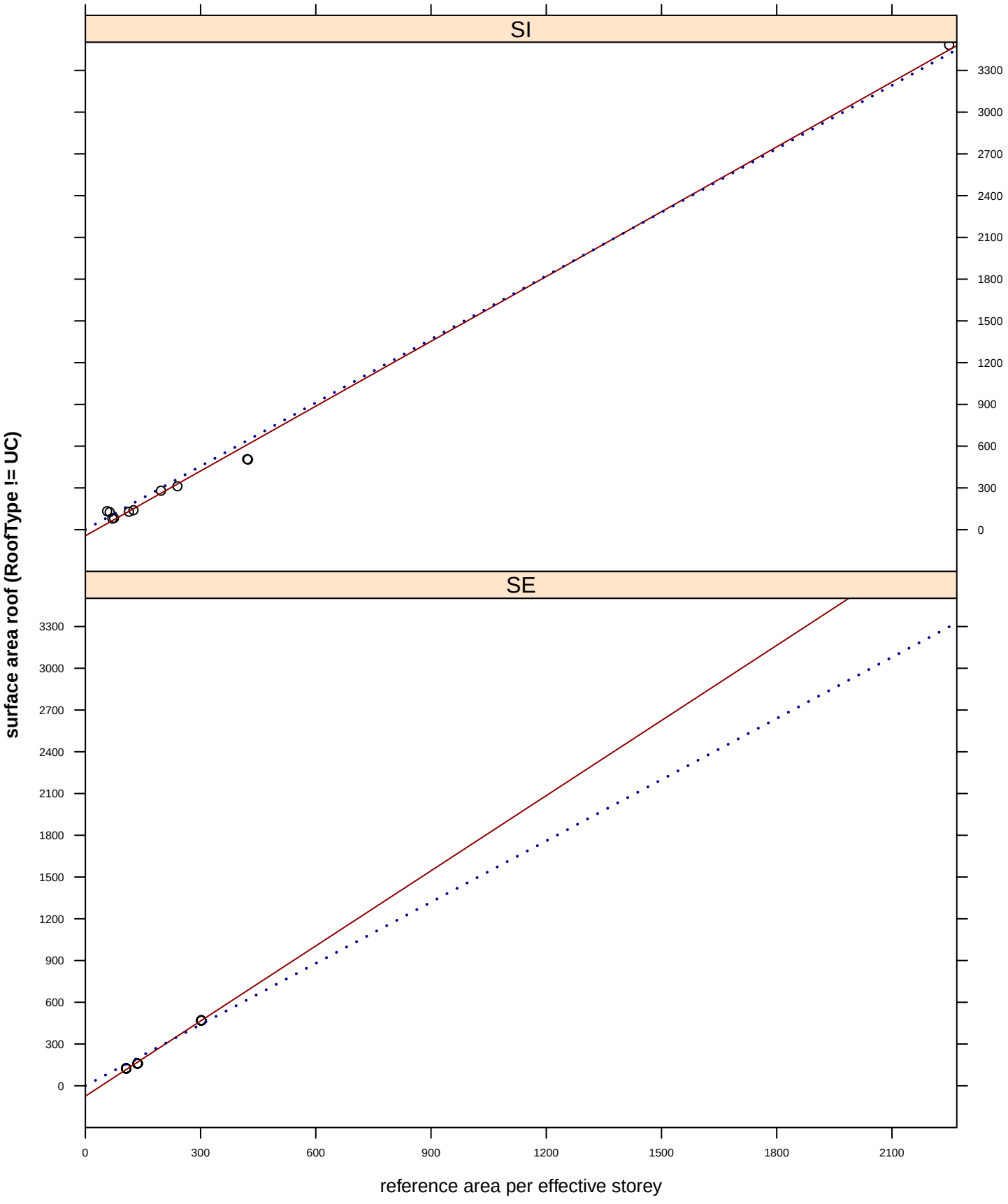
surface area roof (RoofType != UC) ~ reference area per effective storey
by countries II



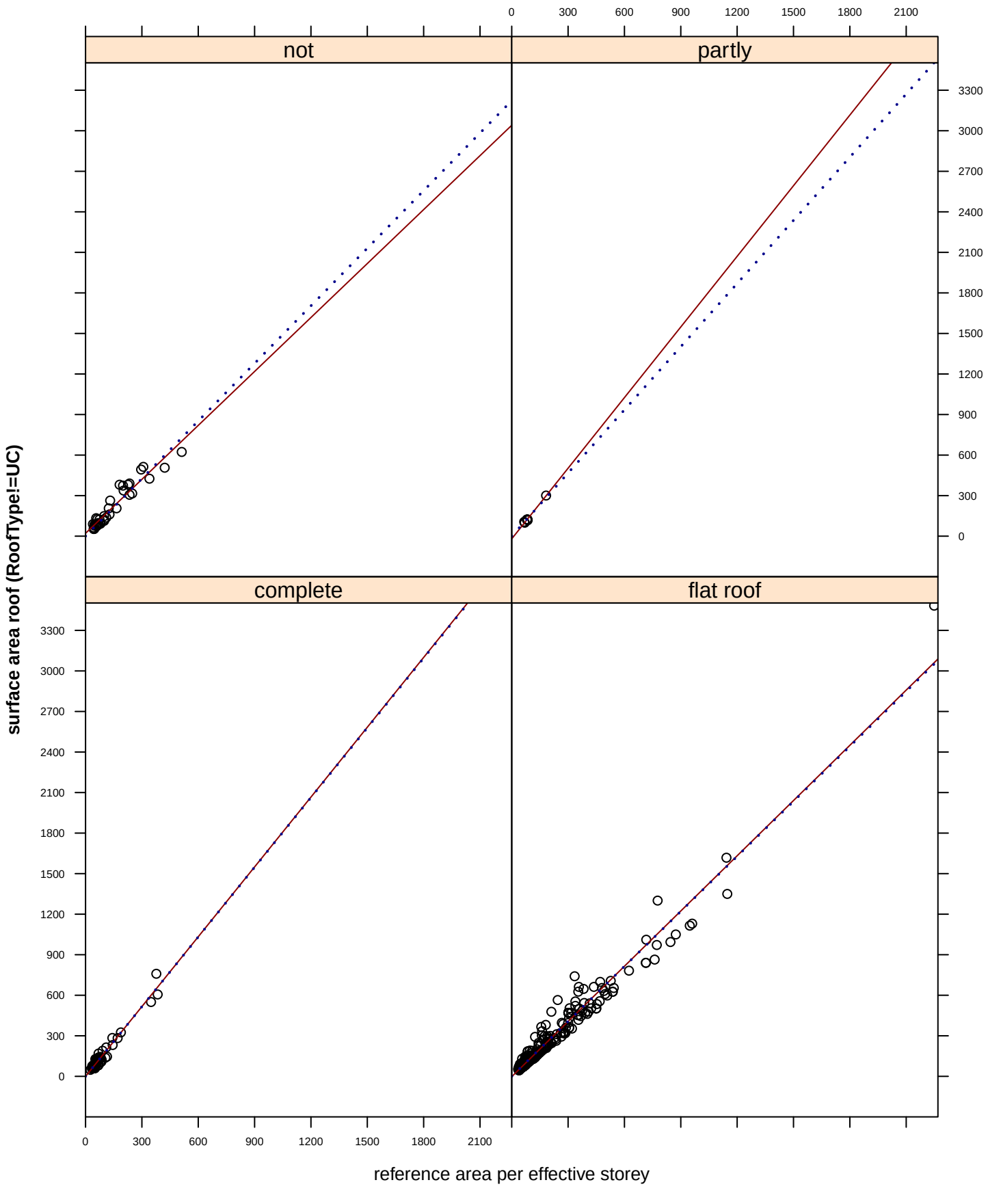
Dotted: With zero crossing


surface area roof (RoofType != UC) ~ reference area per effective storey
by countries III
PL
RS
NL
NO
IE
IT
surface area roof (RoofType != UC)
reference area per effective storey
0
200
400
600
800
1000
1200
1400
1600
Dotted: With zero crossing

surface area roof (RoofType != UC) ~ reference area per effective storey
by countries IV



Dotted: With zero crossing

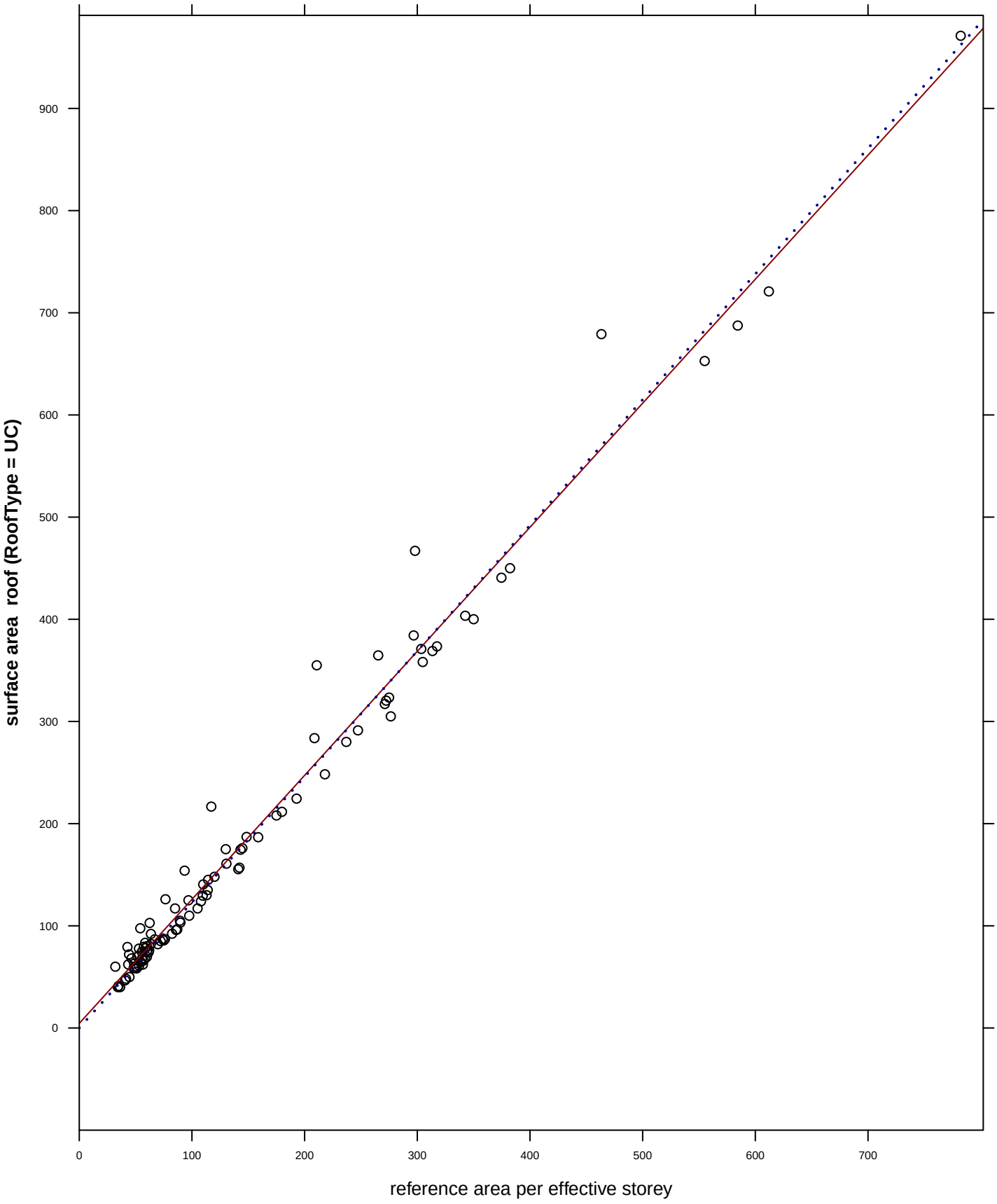

surface area roof (RoofType!=UC) ~ reference area per effective storey
by attic conditioned
not
partly
complete
flat roof
surface area roof (RoofType!=UC)
reference area per effective storey
0
300
600
900
1200
1500
1800
2100
2400
2700
3000
3300
Dotted: With zero crossing

Intercept, slope and R^2, slope and R^2 at zerocrossing

surface area roof (RoofType != UC) ~ reference area per effective storey
by attic conditioned

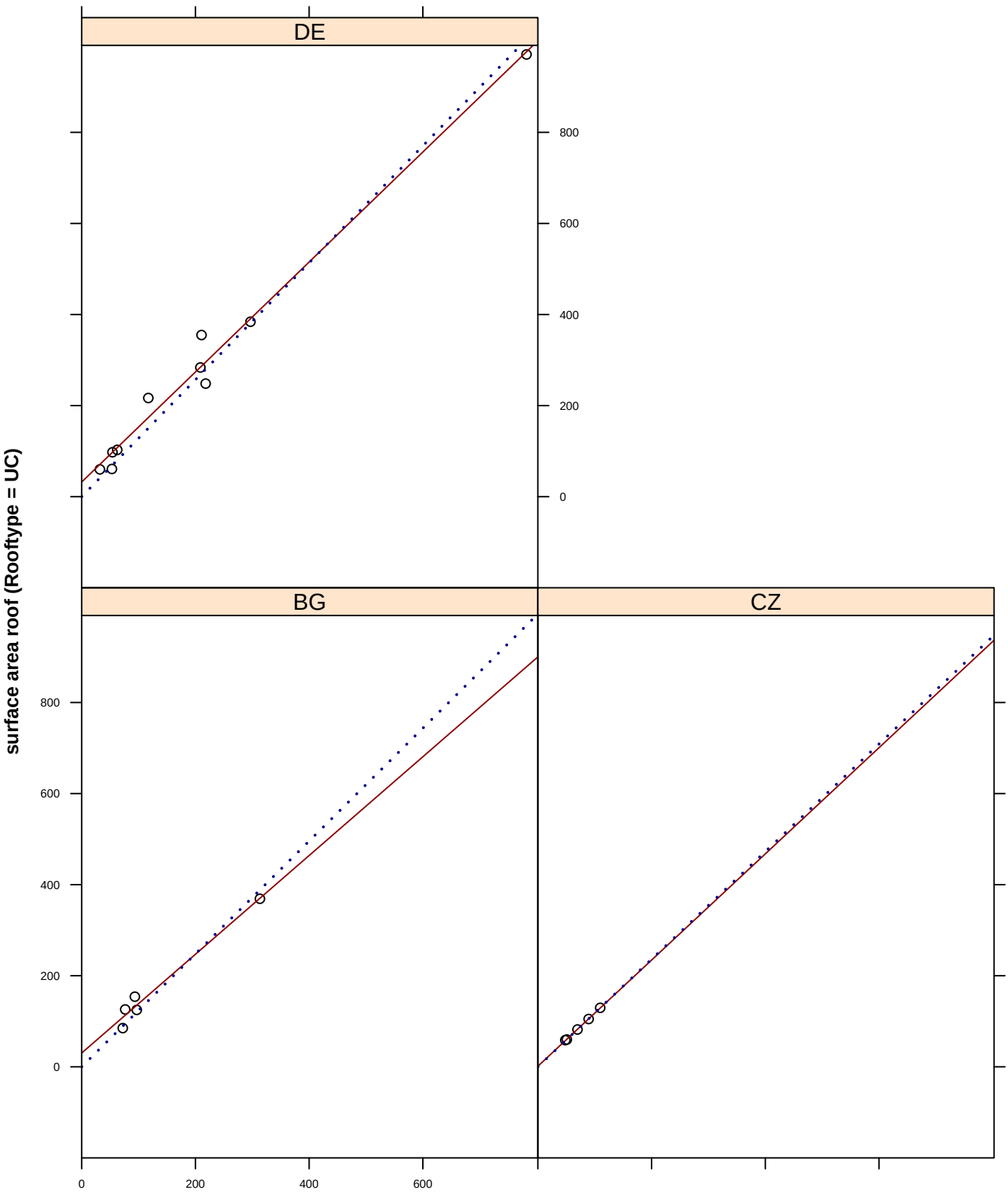
	b	m	R^2	0_m	0_R^2	n
A_Roof/RoofType!=UC: not conditioned	21.013	1.331	0.915	1.421	0.967	37
A_Roof/RoofType!=UC: partly conditioned	−19.886	1.742	0.992	1.558	0.996	7
A_Roof/RoofType!=UC: completely condit.	−0.417	1.722	0.959	1.719	0.981	71
A_Roof/RoofType!=UC: flat roof	−2.536	1.362	0.958	1.357	0.977	254

surface area roof (RoofType = UC) ~ reference area per effective storey (n= 99)
R^2 = 0.98 ,b = 4.51 , m = 1.21



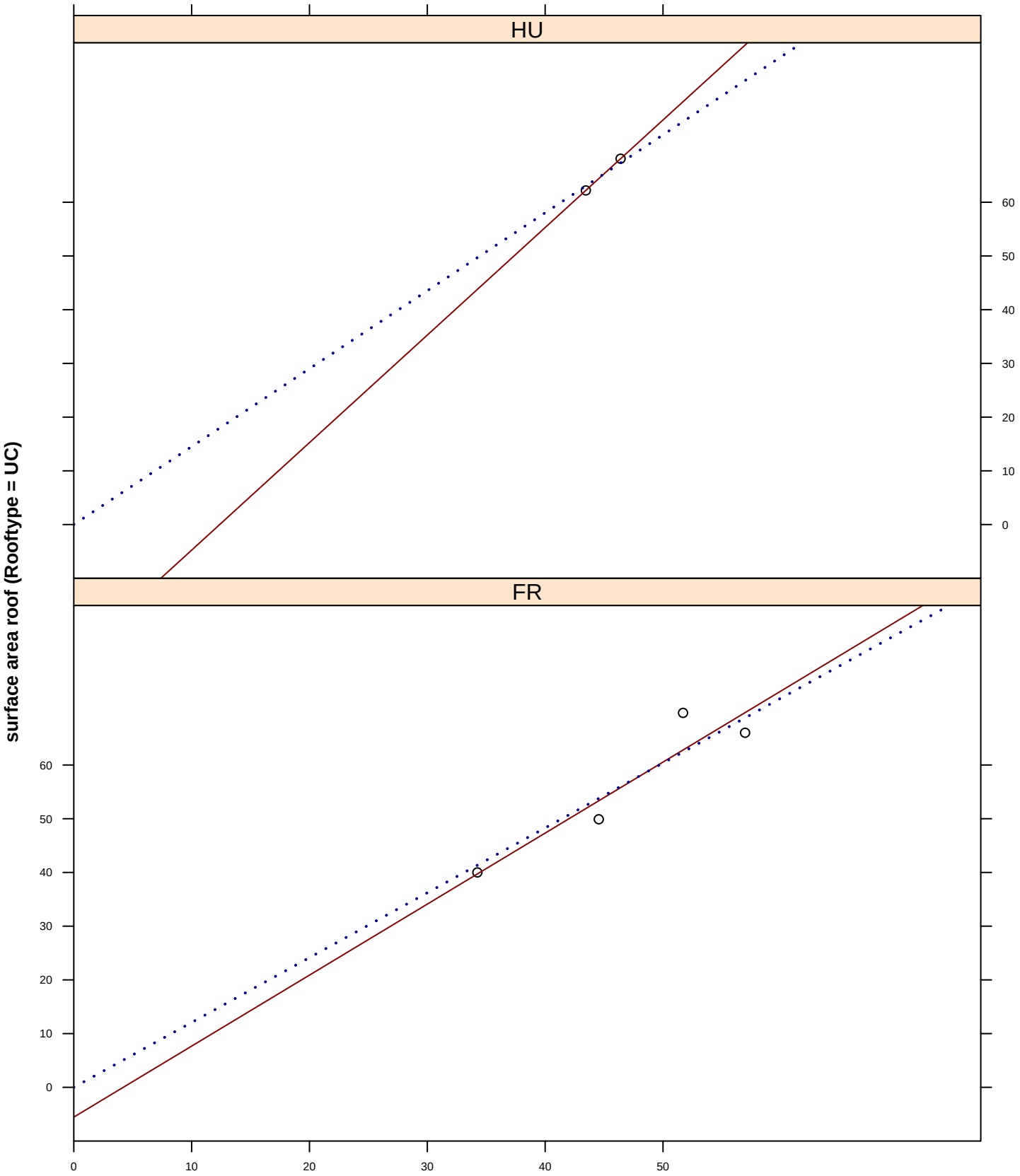
(Dotted = zero crossing: R^2 = 0.99 , m = 1.22)

surface area roof (Rooftype = UC) ~ reference area per effective storey
by countries I

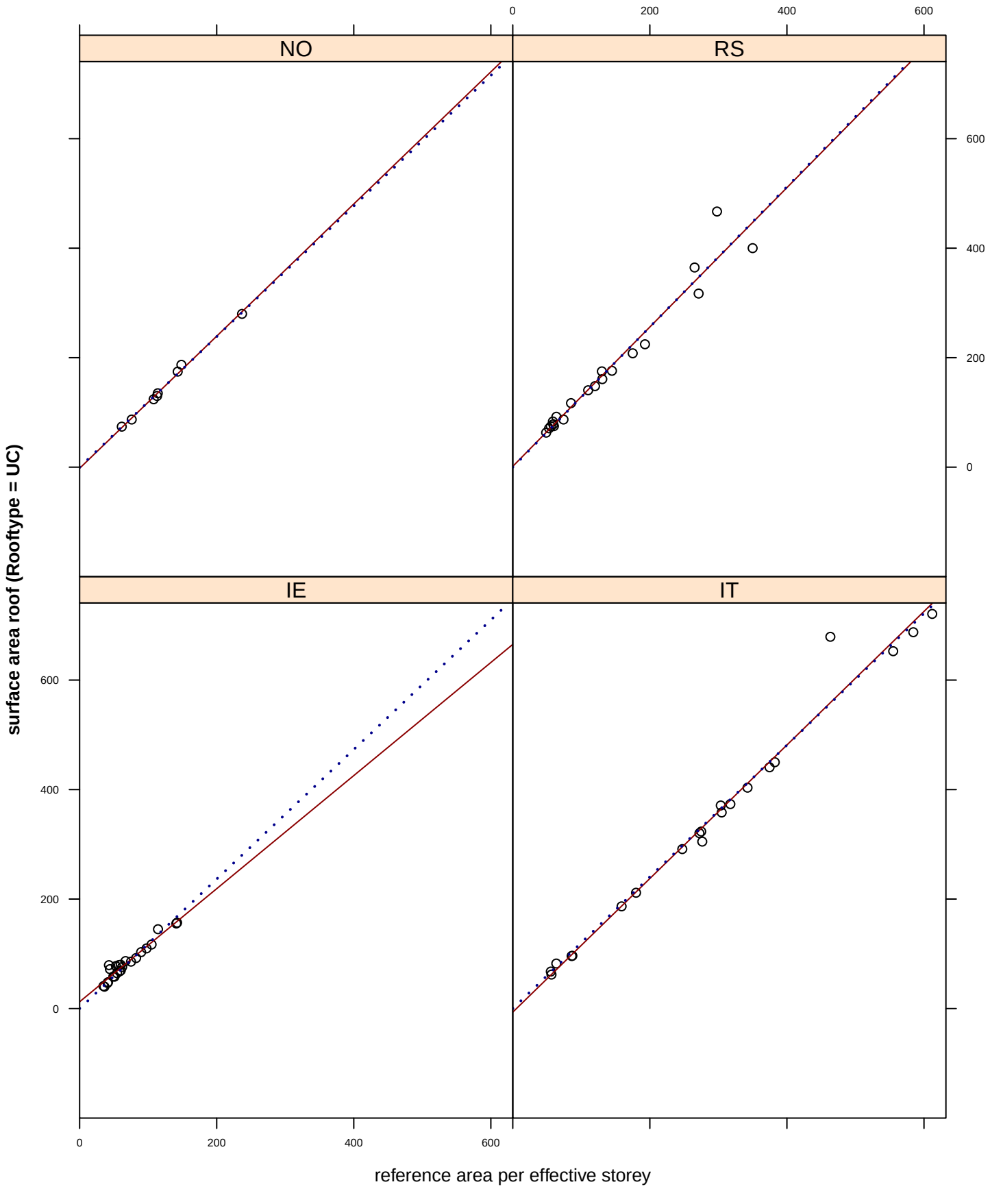


Dotted: With zero crossing

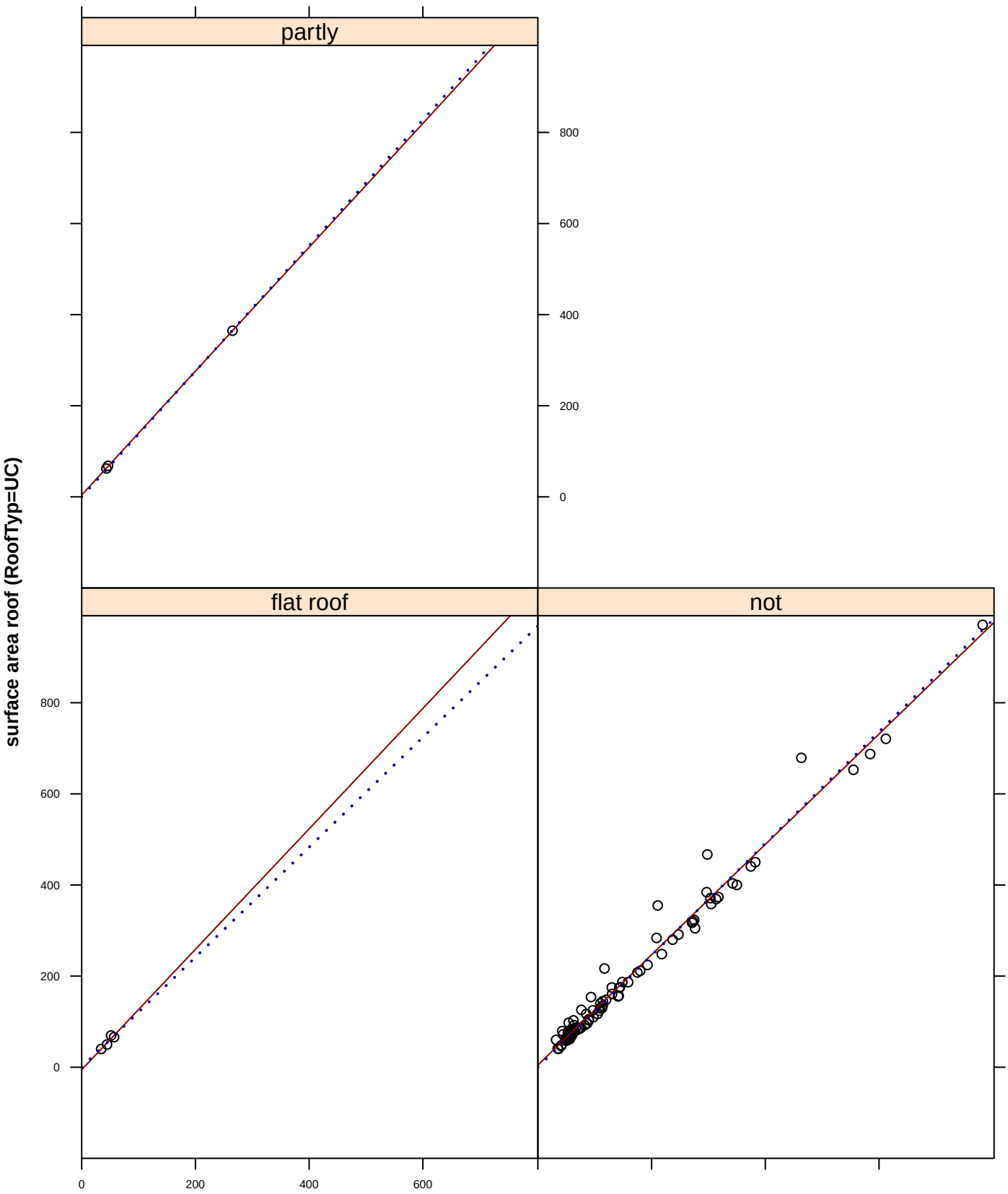
surface area roof (Rooftype = UC) ~ reference area per effective storey
by countries II



Dotted: With zero crossing


surface area roof (Rooftype = UC) ~ reference area per effective storey
by countries III
NO
RS
IE
IT
surface area roof (Rooftype = UC)
reference area per effective storey
0
200
400
600
Dotted: With zero crossing

surface area roof (RoofTyp=UC) ~ reference area per effective storey
by attic conditioned



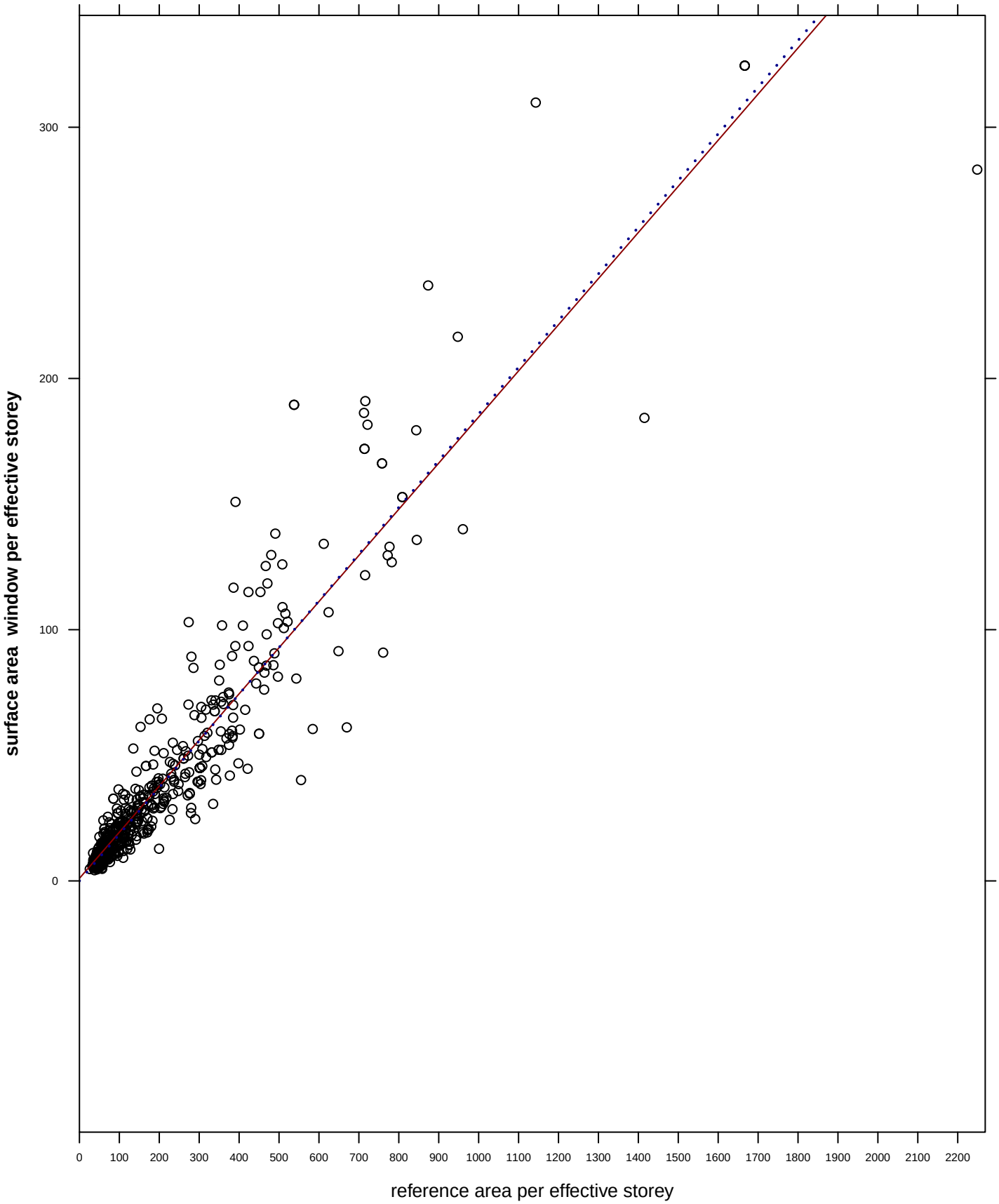
Dotted: With zero crossing

Intercept, slope and R^2, slope and R^2 at zerocrossing

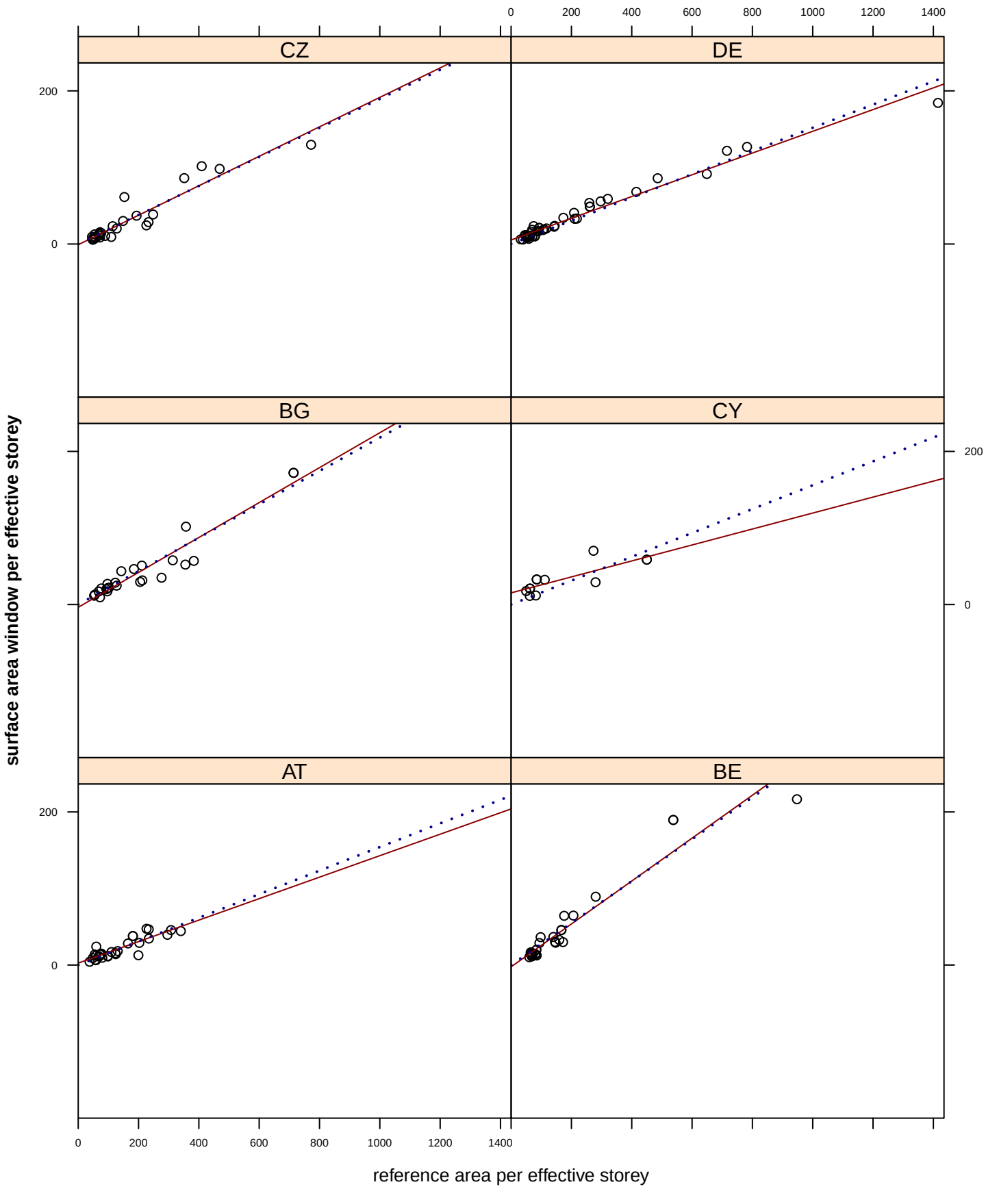
surface area roof (RoofType = UC) ~ reference area per effective storey
by attic conditioned

	b	m	R^2	0_m	0_R^2	n
A_Roof/RoofType=UC: not conditioned	4.6	1.211	0.981	1.227	0.991	92
A_Roof/RoofType=UC: partly conditioned	4.073	1.359	1	1.379	1	3
A_Roof/RoofType=UC: completely condit.						
A_Roof/RoofType=UC: flat roof	−5.549	1.322	0.873	1.207	0.994	4

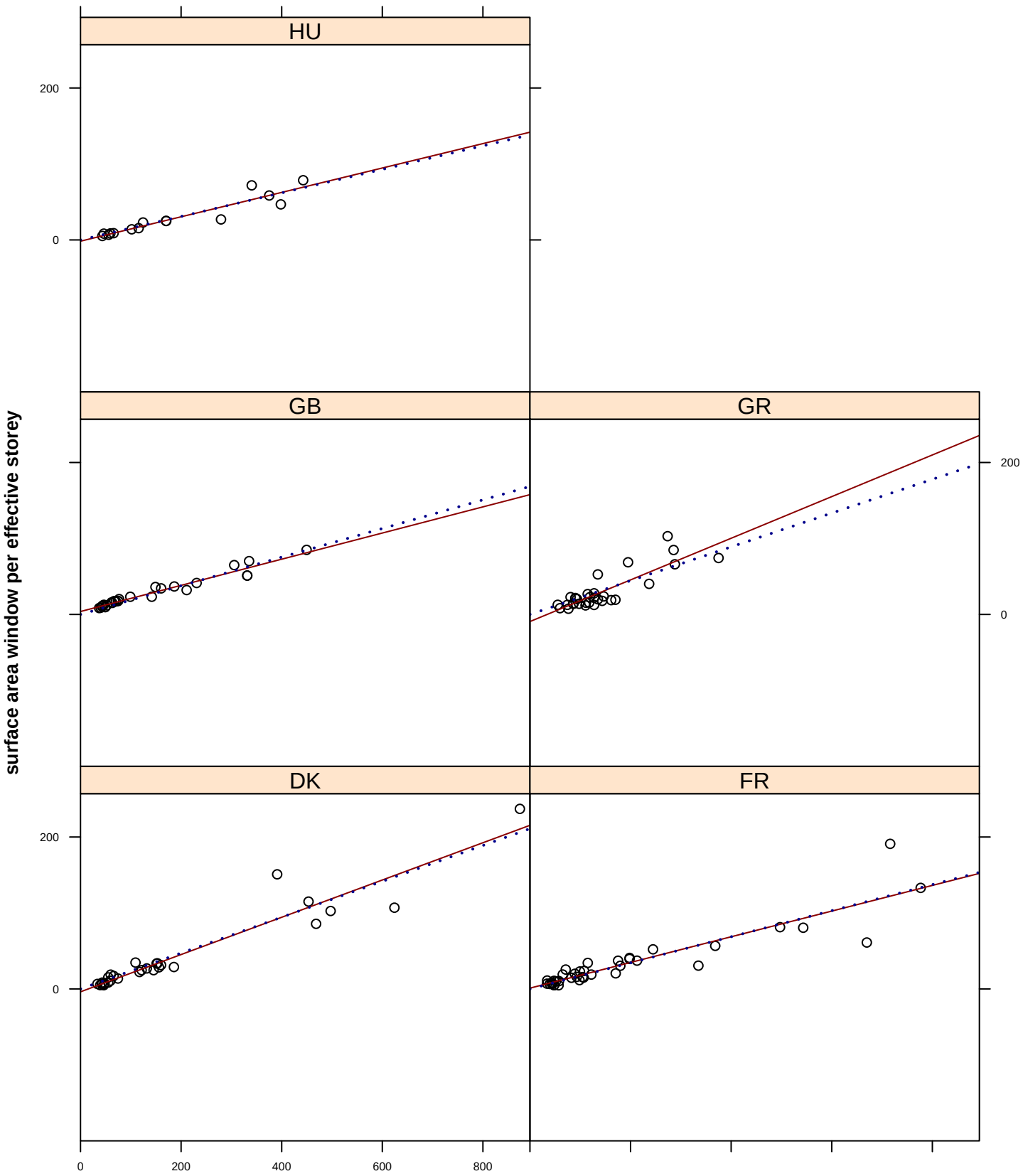
surface area window per effective storey ~ reference area per effective storey (n= 583)
R^2 = 0.87 ,b = 1.02 , m = 0.18



(Dotted = zero crossing: R^2 = 0.92 , m = 0.18)

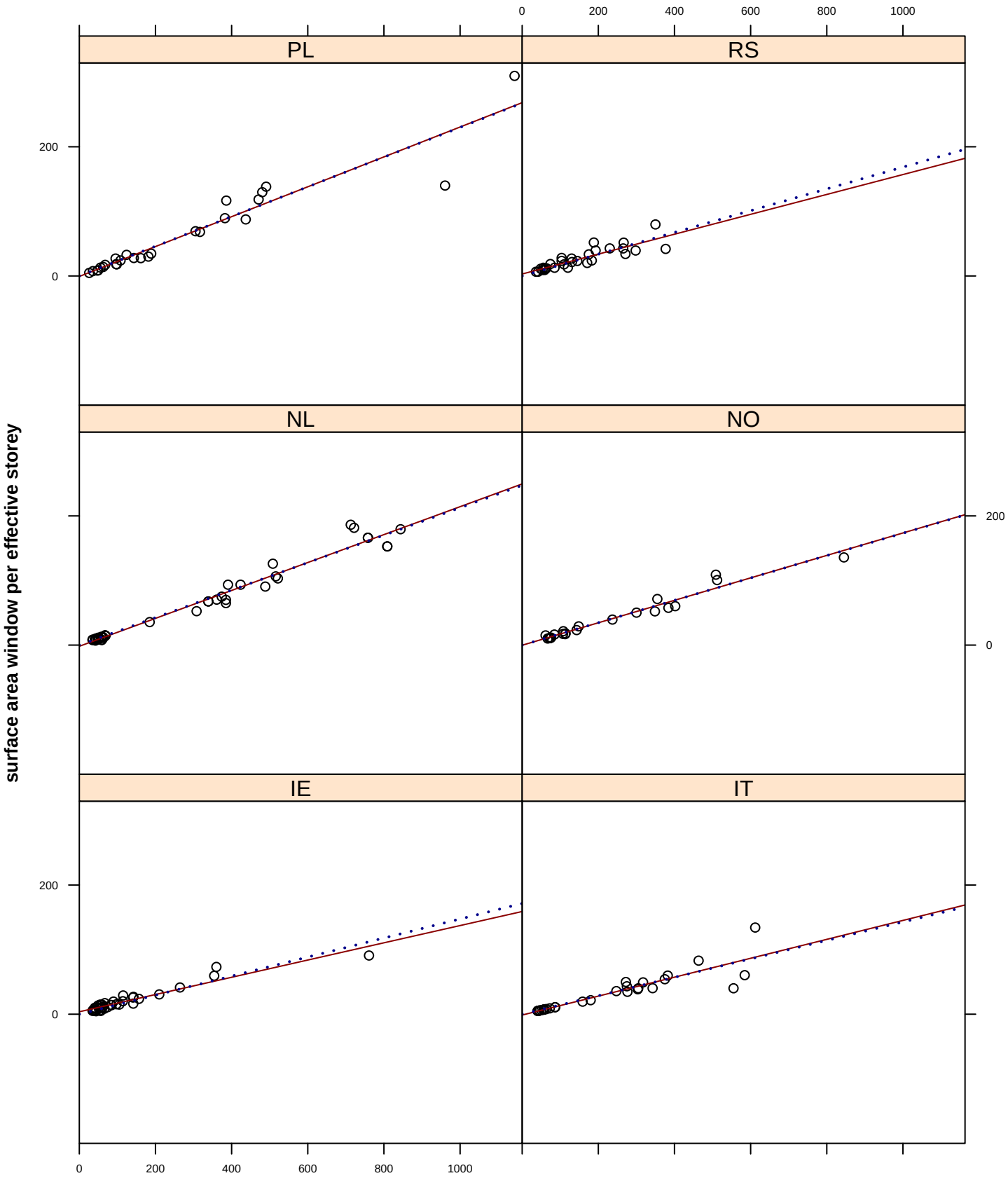

surface area window per effective storey ~ reference area per effective storey
by countries I
CZ
DE
BG
CY
AT
BE
surface area window per effective storey
reference area per effective storey
0
200
400
600
800
1000
1200
1400
Dotted: With zero crossing

surface area window per effective storey ~ reference area per effective storey
by countries II



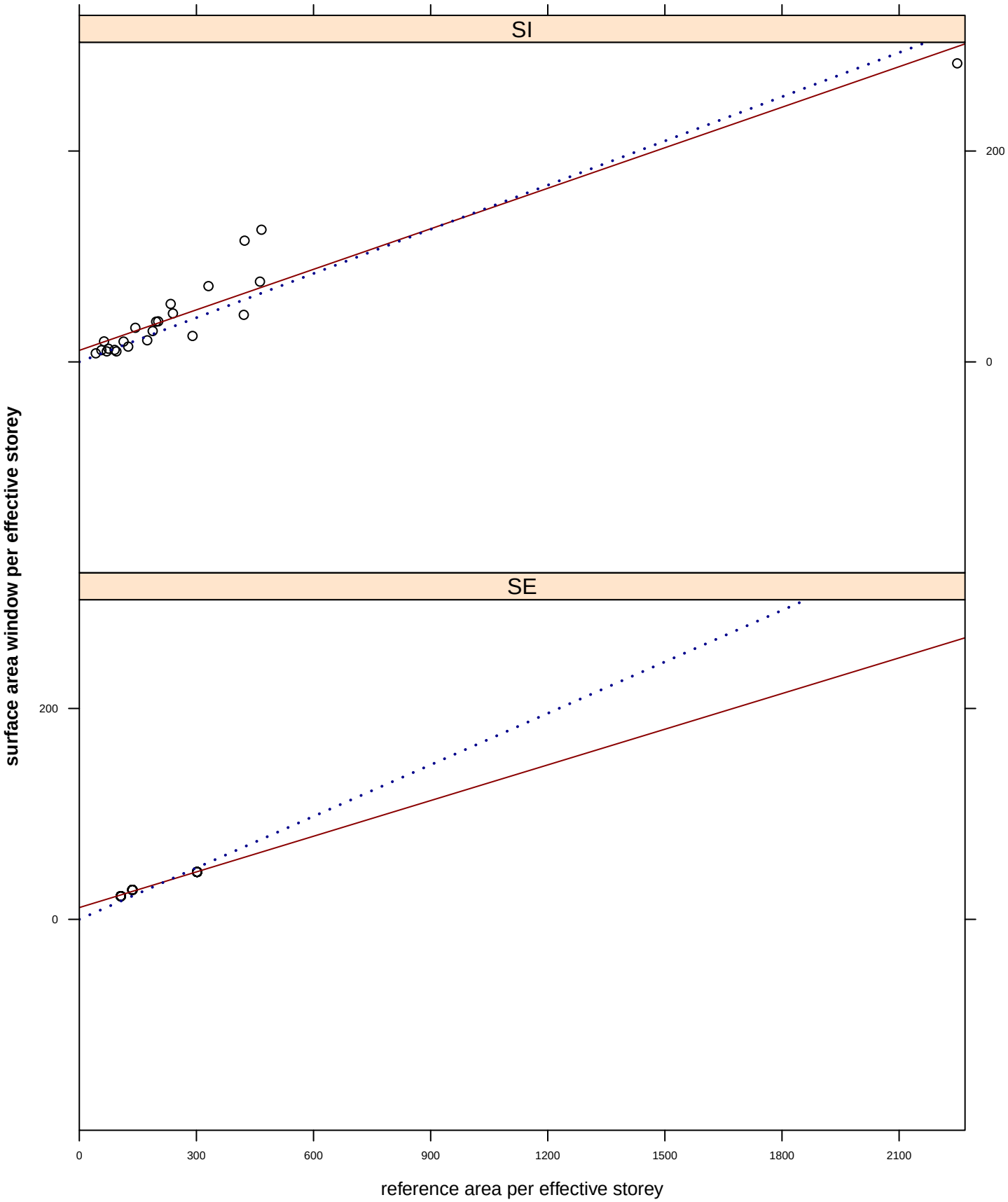
Dotted: With zero crossing

surface area window per effective storey ~ reference area per effective storey
by countries III



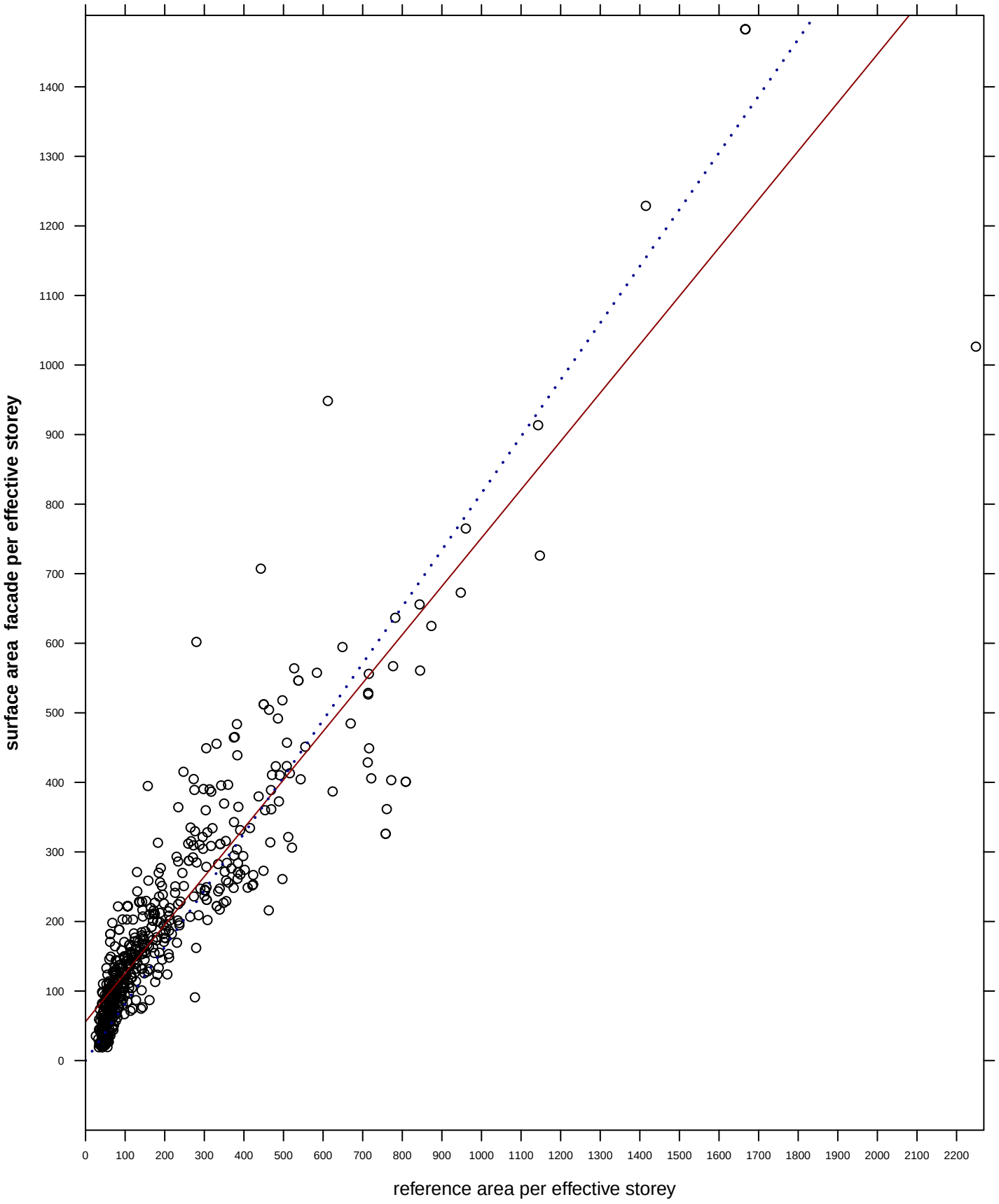
Dotted: With zero crossing

surface area window per effective storey ~ reference area per effective storey
by countries IV



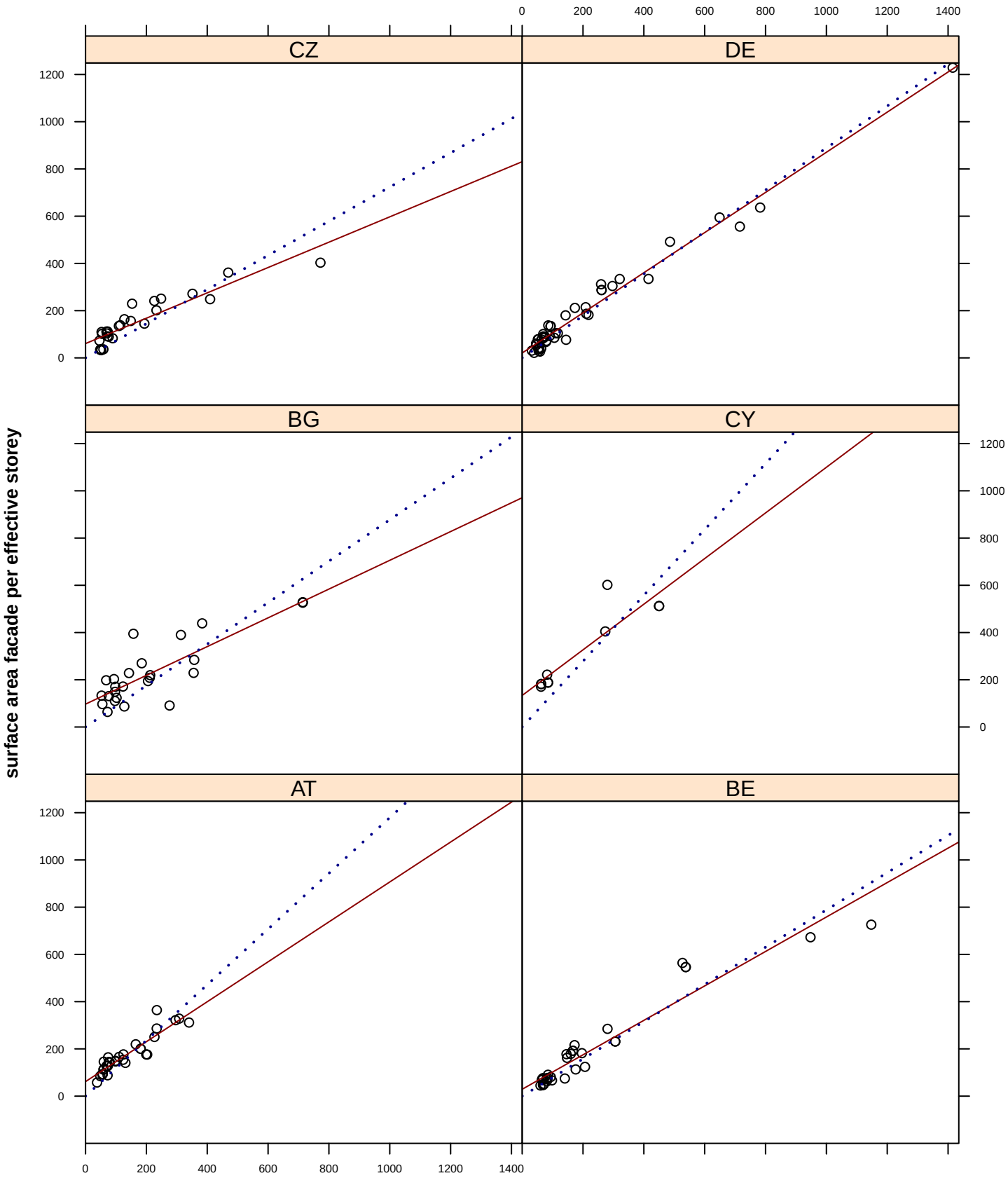
Dotted: With zero crossing

surface area facade per effective storey ~ reference area per effective storey (n= 592)
R^2 = 0.82 ,b = 55.9 , m = 0.69



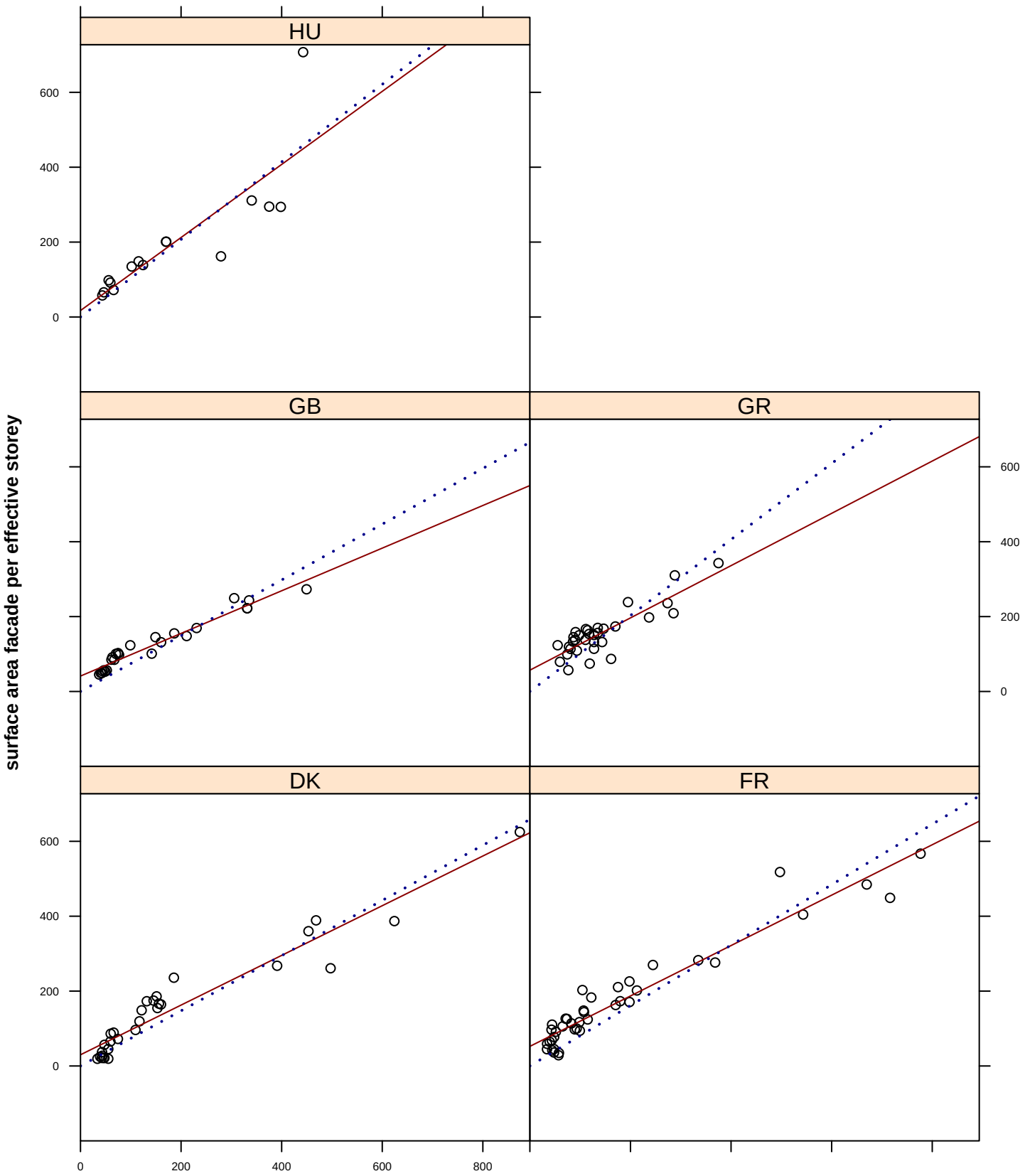
(Dotted = zero crossing: R^2 = 0.89 , m = 0.81)

surface area facade per effective storey ~ reference area per effective storey
by countries I



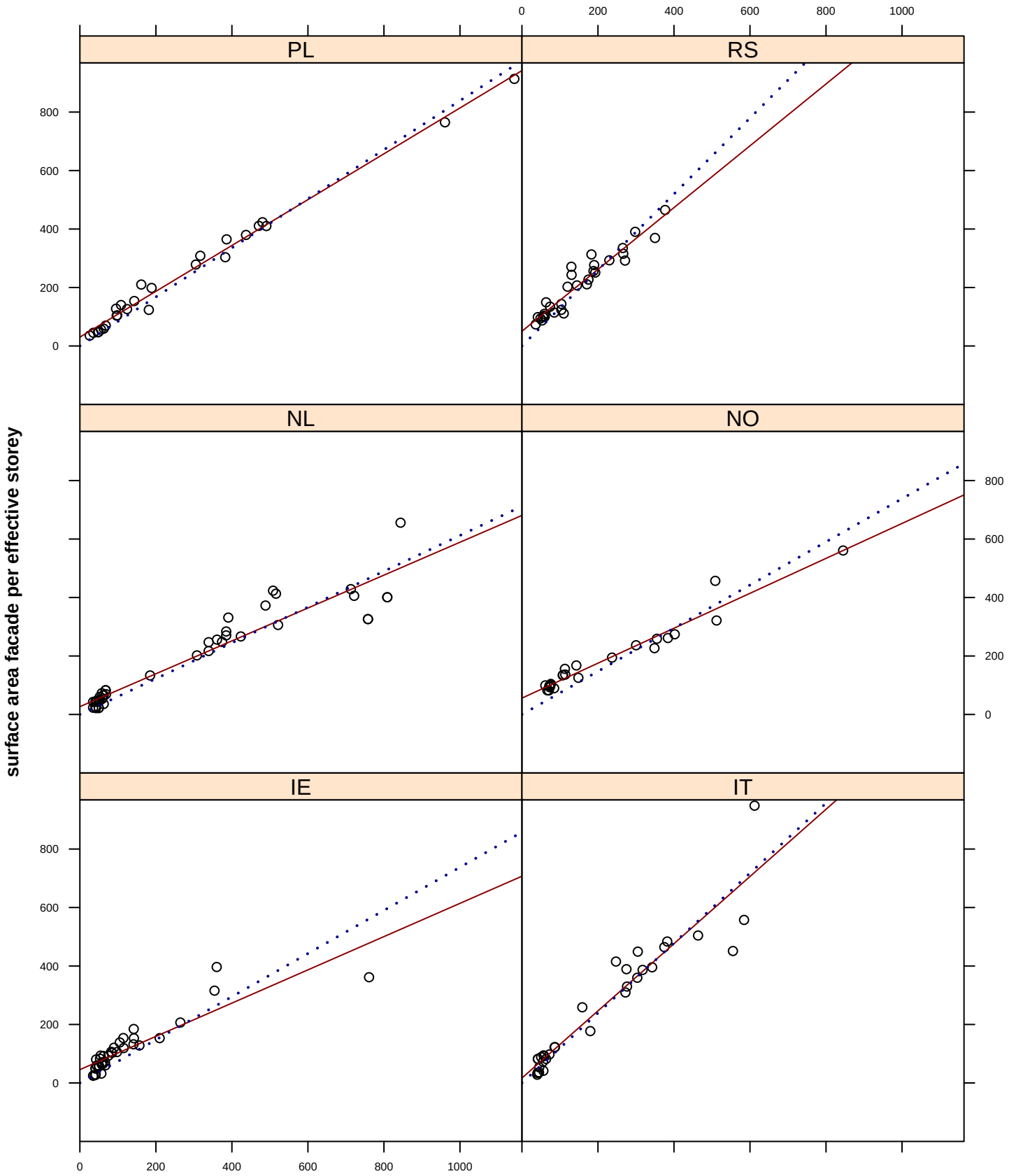
Dotted: With zero crossing

surface area facade per effective storey ~ reference area per effective storey
by countries II



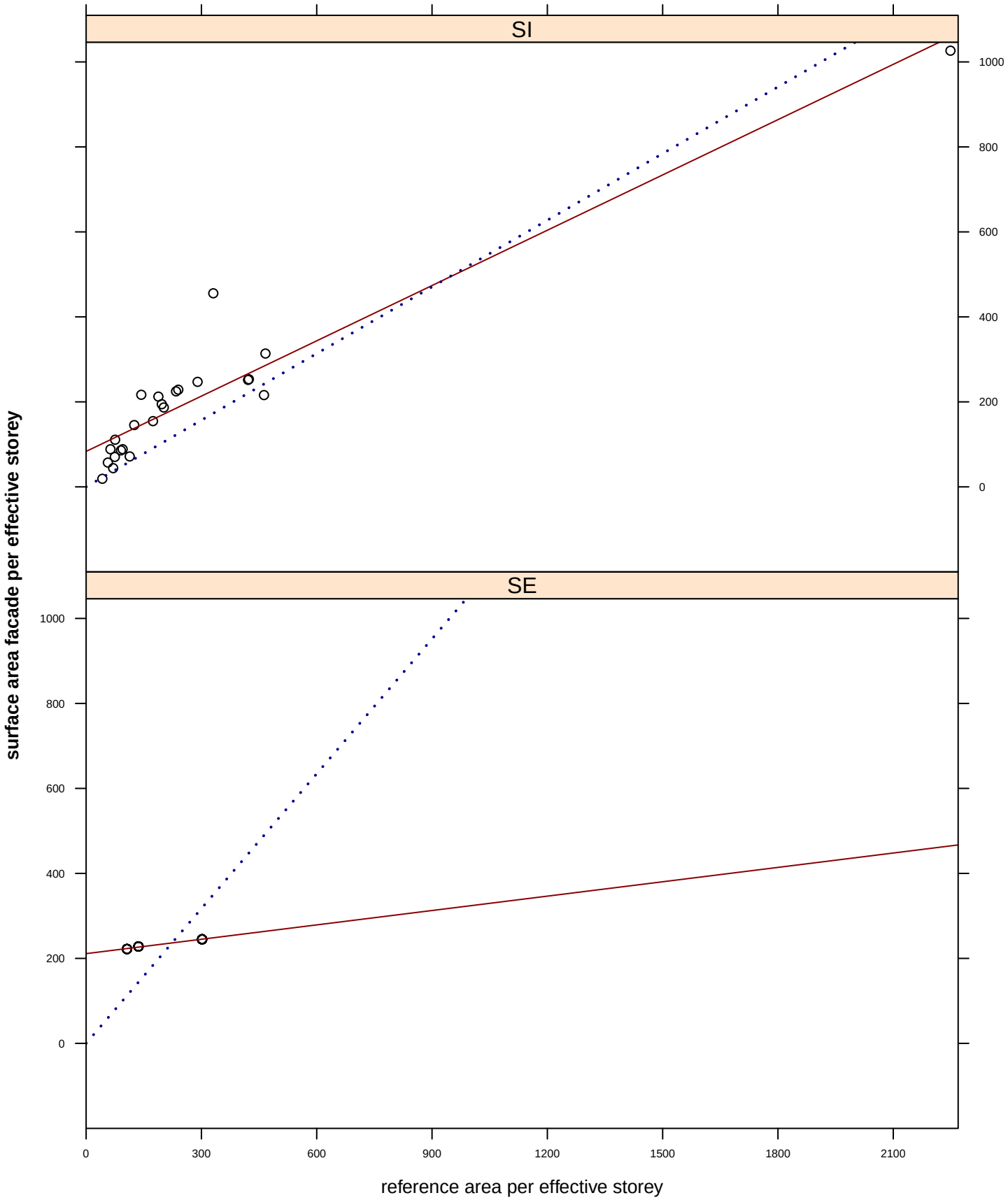
Dotted: With zero crossing

surface area facade per effective storey ~ reference area per effective storey
by countries III



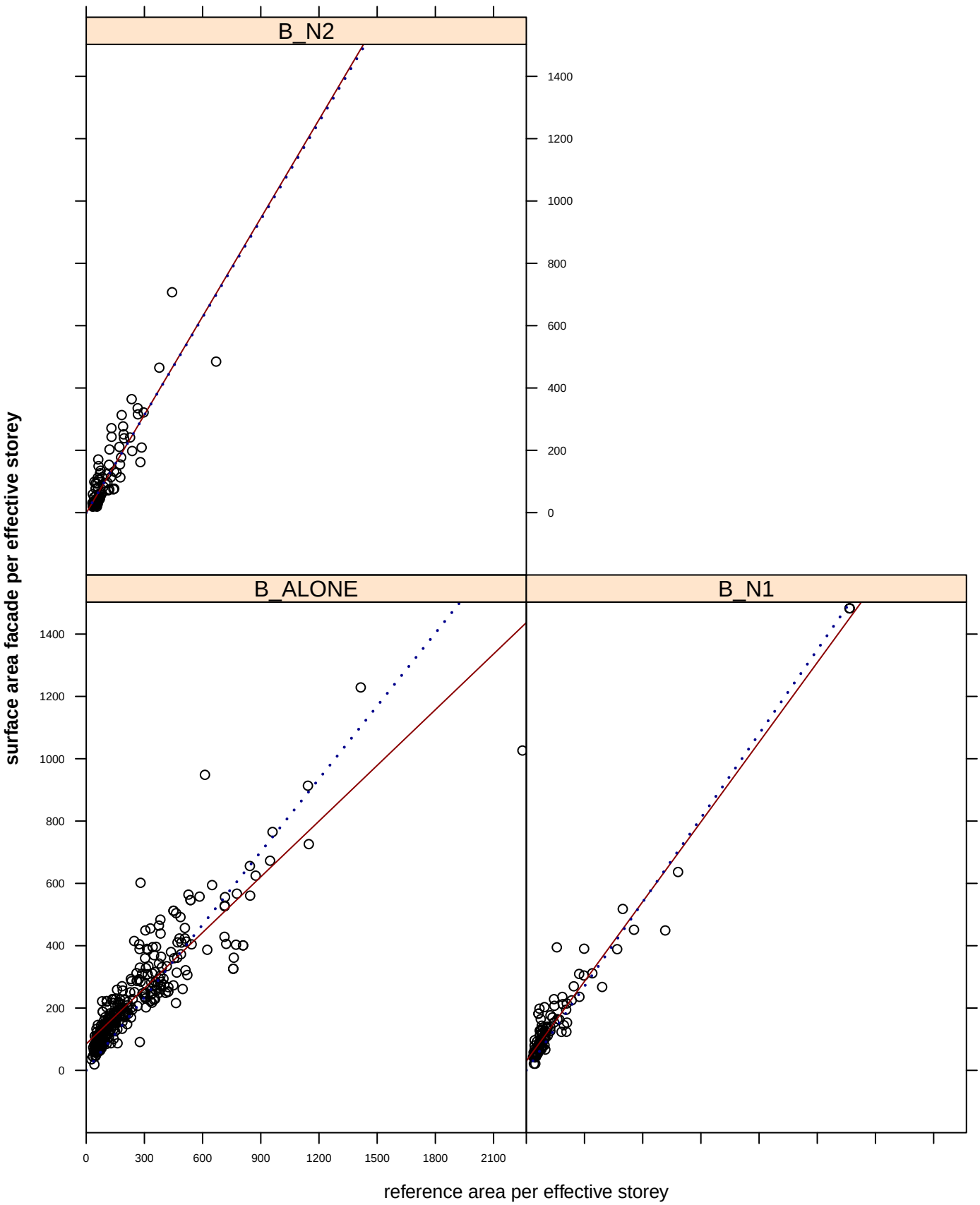
Dotted: With zero crossing

surface area facade per effective storey ~ reference area per effective storey
by countries IV



Dotted: With zero crossing

surface area facade per effective storey ~ reference area per effective storey
by <AttachedNeighbours



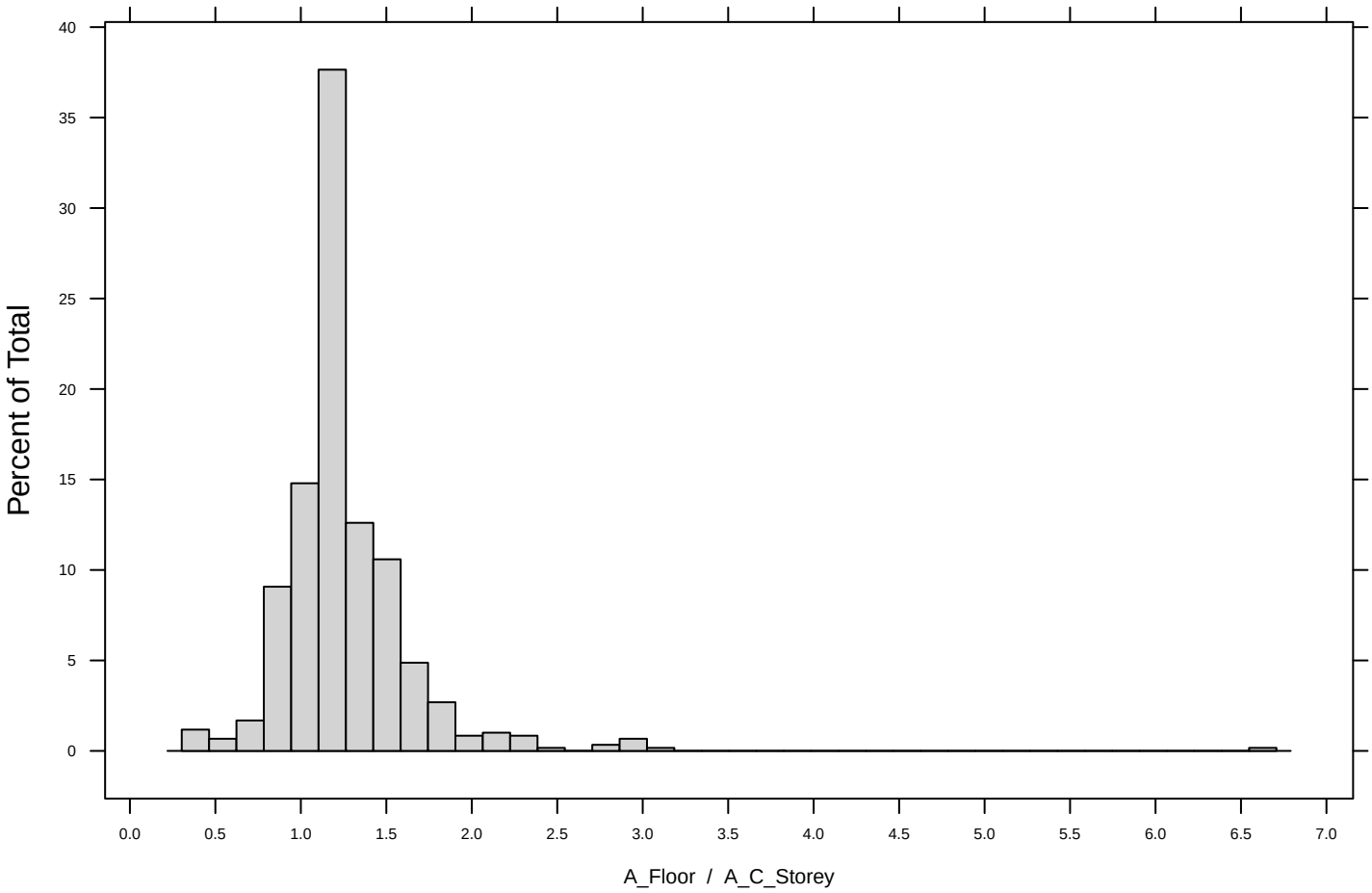
Dotted: With zero crossing

Intercept, slope and R^2, slope and R^2 at zerocrossing

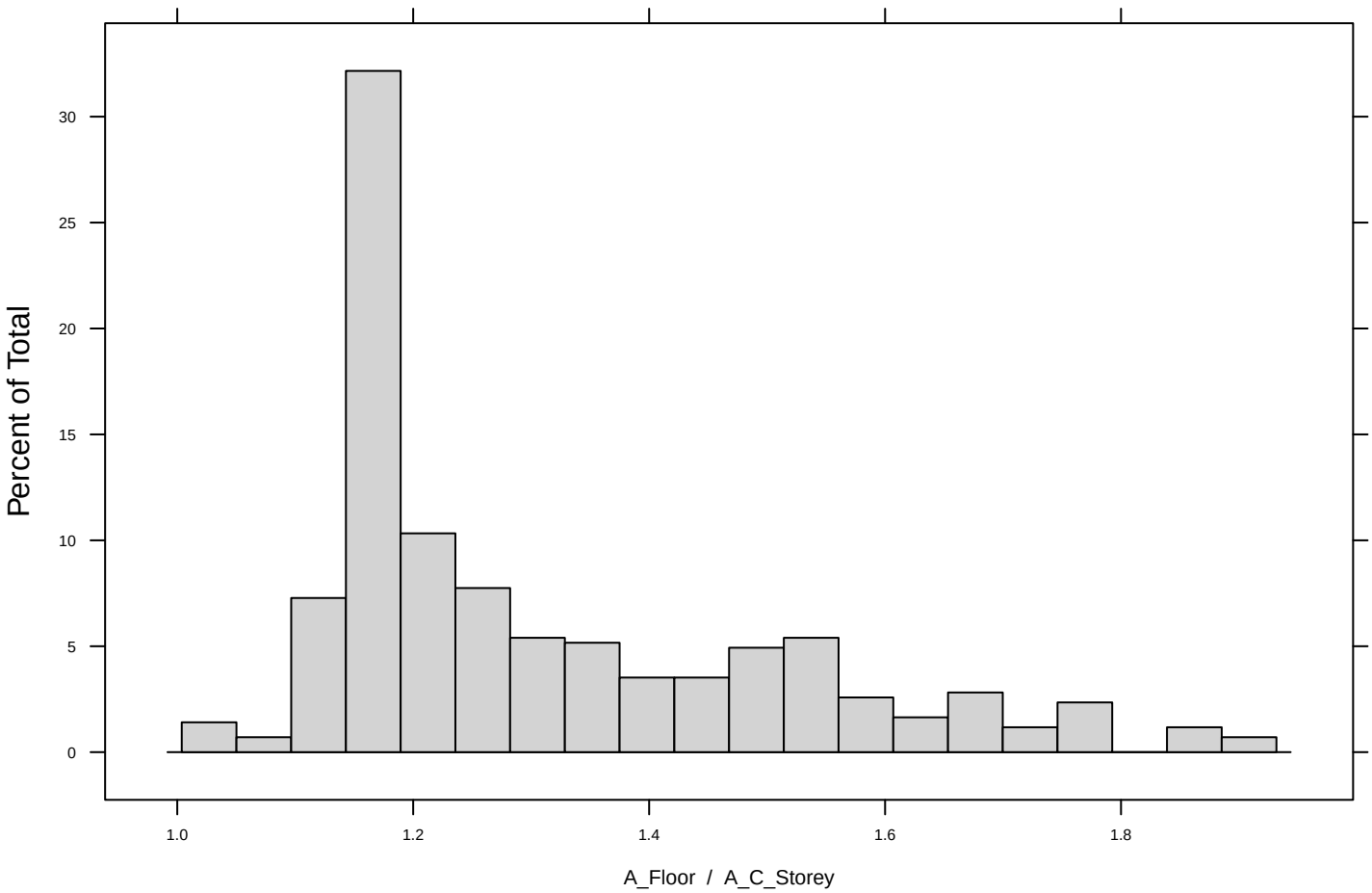
surface area facade per storey ~ reference area per effective storey
by <AttachedNeighbours>

	b	m	R^2	0_m	0_R^2	n
A_Fac_Storey: stand−alone building	84.775	0.596	0.783	0.779	0.881	376
A_Fac_Storey: 1 neighbour	29.712	0.853	0.964	0.9	0.968	116
A_Fac_Storey: 2 neighbours	−1.56	1.052	0.777	1.044	0.88	100

Number of cases: 595 without data correction



Number of cases: 426 AFTER data correction

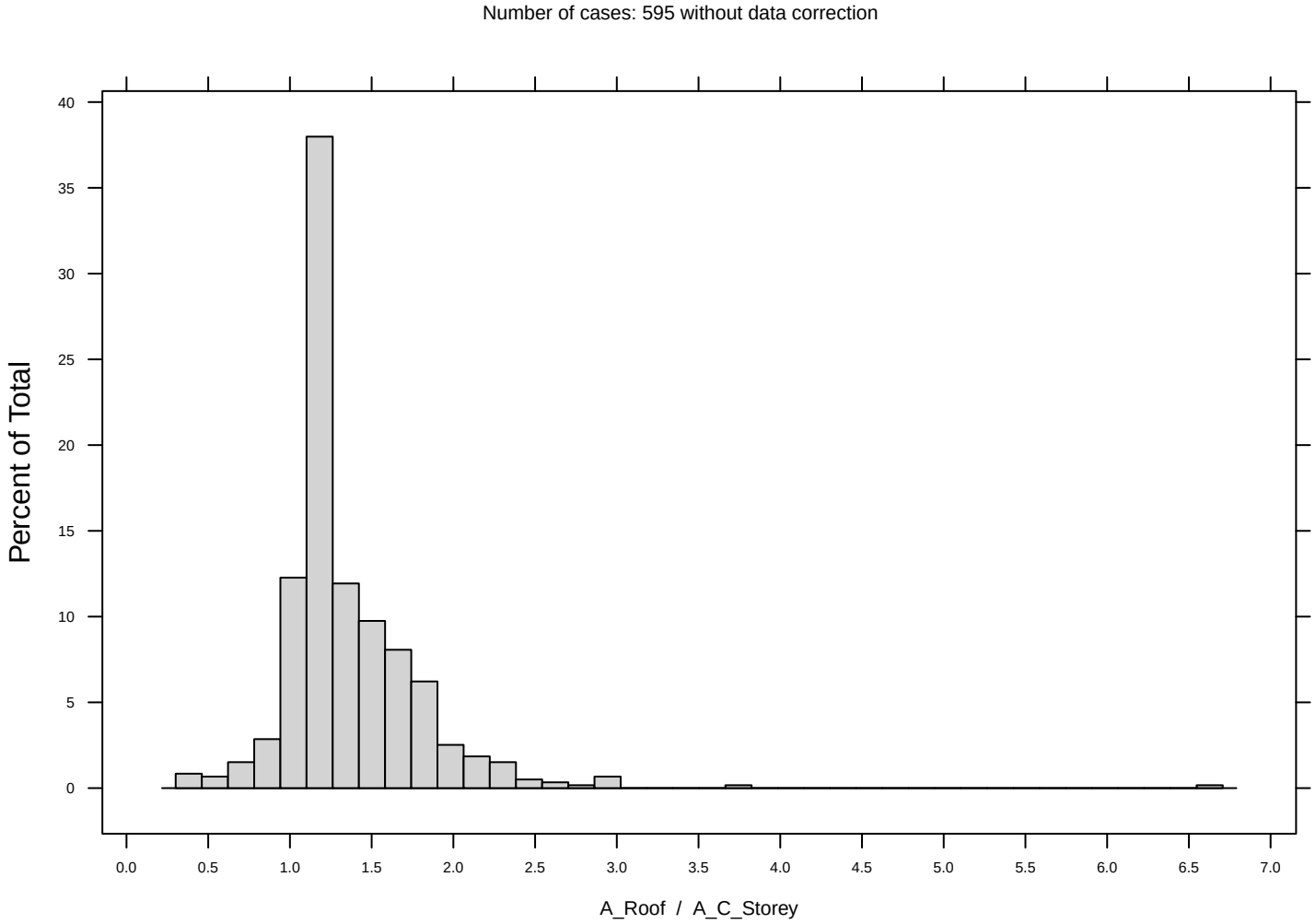


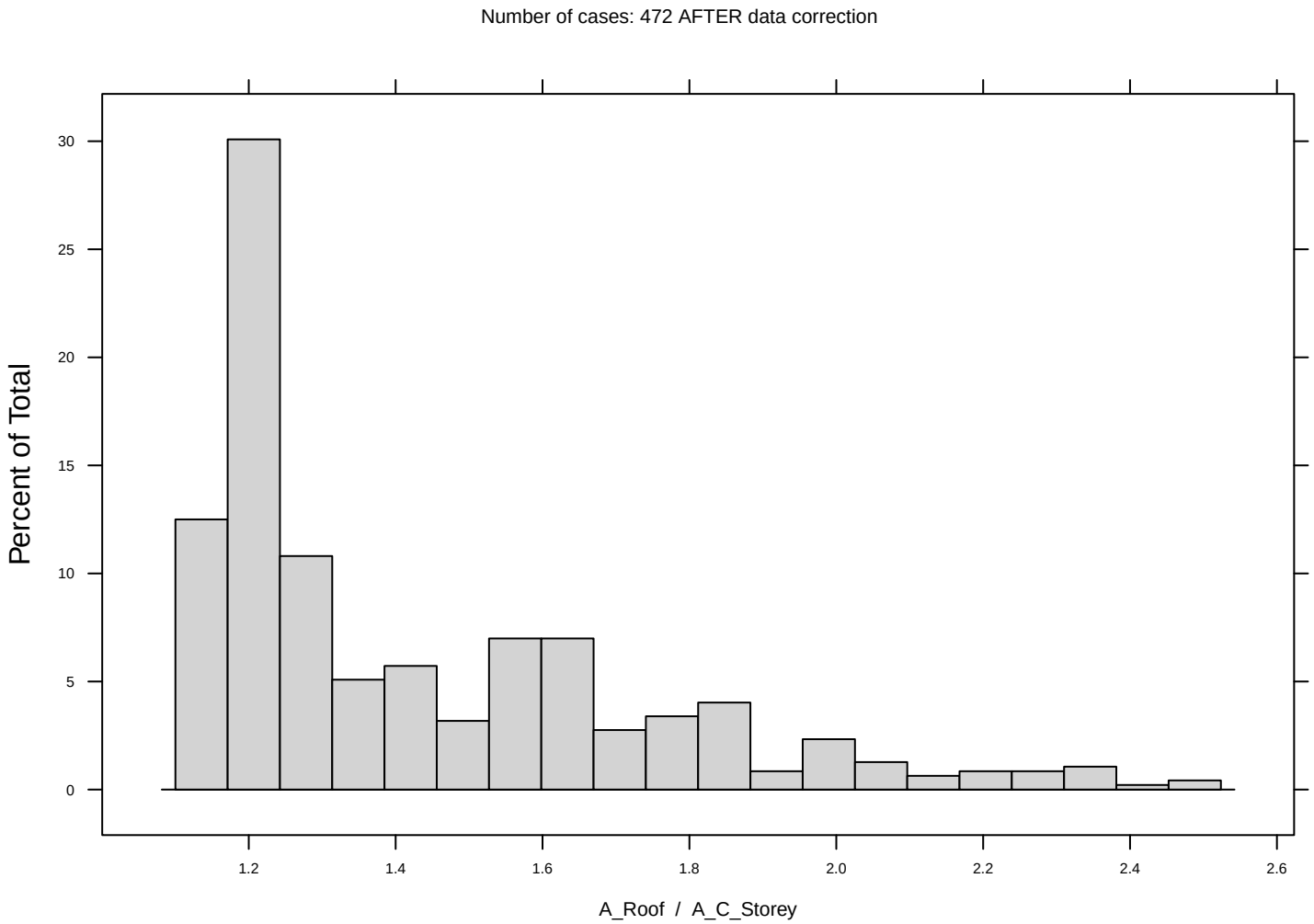
removed cases A_Floor

Code_Building	A_C_Storey	A_Floor	A_Floor/A_C_Storey	Corr
DE.N.SFH.06.Gen.ReEx.001	173.30000	152.3	0.8788229	P
DE.N.SFH.08.Gen.ReEx.001	85.82857	75.3	0.8773302	P
DE.N.TH.03.Gen.ReEx.001	56.40000	50.4	0.8936170	P
DE.N.TH.04.Gen.ReEx.001	74.80000	81.2	1.0855615	P
DE.N.TH.05.Gen.ReEx.001	58.70000	46.2	0.7870528	P
DE.N.TH.09.Gen.ReEx.001	54.10909	51.9	0.9591734	P
DE.N.TH.11.Gen.ReEx.001	71.20000	67.8	0.9522472	P
DE.N.TH.12.Gen.ReEx.001	71.20000	67.8	0.9522472	P
DE.N.MFH.08.Gen.ReEx.001	259.36667	249.4	0.9615731	P
DE.N.MFH.10.Gen.ReEx.001	648.91852	619.5	0.9546653	P
DE.N.AB.05.Gen.ReEx.001	485.92500	459.2	0.9450018	P
DE.N.AB.05.HR.ReEx.001	715.55000	754.9	1.0549927	P
DE.N.AB.06.HR.ReEx.001	1415.22857	1469.0	1.0379949	P
PL.N.AB.03.Gen.ReEx.001	385.98182	416.0	1.0777710	P
PL.N.MFH.01.Gen.ReEx.001	161.50000	334.0	2.0681115	P
PL.N.TH.01.Gen.ReEx.001	124.10000	292.0	2.3529412	P
PL.N.TH.04.Gen.ReEx.001	95.20000	101.0	1.0609244	P
PL.N.TH.05.Gen.ReEx.001	143.15000	154.0	1.0757946	P
XX.N.MFH.01.Gen.ReEx.001	1666.50000	754.9	0.4529853	P
XX.N.MFH.02.Gen.ReEx.001	1666.50000	754.9	0.4529853	P
XX.N.MFH.03.Gen.ReEx.001	1666.50000	754.9	0.4529853	P
BG.N.SFH.01.Gen.ReEx.001	52.70000	150.0	2.8462998	P
BG.N.SFH.02.Gen.ReEx.001	97.80000	70.0	0.7157464	P
BG.N.SFH.03.Gen.ReEx.001	72.25000	225.0	3.1141869	P
BG.N.SFH.04.Gen.ReEx.001	96.90000	74.5	0.7688338	P
BG.N.SFH.05.Gen.ReEx.001	127.50000	110.0	0.8627451	P
BG.N.SFH.02.Class.ReEx.001	184.73333	120.0	0.6495850	P
BG.N.TH.01.Gen.ReEx.001	67.80000	161.0	2.3746313	P
BG.N.MFH.01.Gen.ReEx.001	383.35000	292.0	0.7617060	P
BG.N.MFH.02.Gen.ReEx.001	95.20000	264.0	2.7731092	P
BG.N.MFH.03.Gen.ReEx.001	212.50000	172.0	0.8094118	P
BG.N.MFH.02.Class.ReEx.001	276.26667	97.0	0.3511100	P
BE.N.SFH.01.Gen.ReEx.001	172.14545	134.3	0.7801542	P
BE.N.TH.01.Gen.ReEx.001	80.84211	75.7	0.9363932	P
BE.N.SFH.02.Gen.ReEx.001	145.74545	126.7	0.8693239	P
BE.N.SFH.03.Gen.ReEx.001	147.41818	146.4	0.9930932	P
BE.N.SFH.04.Gen.ReEx.001	159.70909	138.8	0.8690801	P
BE.N.TH.04.Gen.ReEx.001	68.54737	63.2	0.9219902	P
BE.N.SFH.05.Gen.ReEx.001	166.69091	131.9	0.7912849	P
BE.N.TH.05.Gen.ReEx.001	71.53684	60.0	0.8387287	P
BE.N.SFH.06.Gen.ReEx.001	166.69091	131.9	0.7912849	P
BE.N.TH.06.Gen.ReEx.001	71.53684	60.0	0.8387287	P
RS.N.SFH.04.Gen.ReEx.001	36.25000	82.0	2.2620690	P
RS.N.MFH.04.Gen.ReEx.001	230.00000	237.0	1.0304348	P
RS.N.TH.07.Gen.ReEx.001	41.77778	101.2	2.4223404	P
GR.ZoneB.SFH.02.Gen.ReEx.001	97.76667	88.0	0.9001023	P
GR.ZoneB.MFH.01.Gen.ReEx.001	285.60000	100.0	0.3501401	P
GR.ZoneD.SFH.03.Gen.ReEx.001	55.25000	47.0	0.8506787	P
GR.ZoneA.SFH.03.Gen.ReEx.001	86.72000	85.0	0.9801661	P
GR.ZoneD.SFH.04.Gen.ReEx.001	111.30000	114.4	1.0278527	P
DK.N.SFH.01.Gen.ReEx.001	131.80000	127.0	0.9635812	P
DK.N.SFH.05.Gen.ReEx.001	153.00000	160.0	1.0457516	P
DK.N.SFH.06.Gen.ReEx.001	117.30000	118.0	1.0059676	P
DK.N.SFH.07.Gen.ReEx.001	121.60000	122.0	1.0032895	P
DK.N.SFH.09.Gen.ReEx.001	145.30000	149.0	1.0254646	P
DK.N.TH.07.Gen.ReEx.001	42.50000	43.0	1.0117647	P
DK.N.TH.08.Gen.ReEx.001	33.70000	34.0	1.0089021	P
DK.N.TH.09.Gen.ReEx.001	55.25000	118.0	2.1357466	P
DK.N.TH.10.Gen.ReEx.001	65.90000	66.3	1.0060698	P
DK.N.AB.01.Gen.ReEx.001	185.70000	201.1	1.0829295	P
DK.N.AB.04.Gen.ReEx.001	155.95000	147.0	0.9426098	P
DK.N.AB.10.Gen.ReEx.001	873.47500	931.4	1.0663156	P
GB.ENG.TH.01.Gen.ReEx.001	52.30000	56.4	1.0783939	P
GB.ENG.TH.07.Gen.ReEx.001	49.20000	47.3	0.9613821	P
GB.ENG.TH.08.Gen.ReEx.001	49.20000	47.3	0.9613821	P
GB.ENG.MFH.01.Gen.ReEx.001	141.66667	149.1	1.0524706	P
GB.ENG.MFH.02.Gen.ReEx.001	160.26667	168.2	1.0495008	P
GB.ENG.MFH.03.Gen.ReEx.001	149.03333	156.7	1.0514426	P
GB.ENG.MFH.04.Gen.ReEx.001	186.46667	195.0	1.0457633	P
GB.ENG.MFH.05.Gen.ReEx.001	211.03333	220.1	1.0429632	P
GB.ENG.MFH.06.Gen.ReEx.001	230.86667	240.3	1.0408605	P
GB.ENG.MFH.07.Gen.ReEx.001	331.46667	342.8	1.0341915	P
GB.ENG.MFH.08.Gen.ReEx.001	331.46667	342.8	1.0341915	P
GB.ENG.AB.03.Gen.ReEx.001	305.60909	316.5	1.0356367	P
GB.ENG.AB.04.Gen.ReEx.001	335.16154	360.1	1.0744073	P
GB.ENG.AB.07.Gen.ReEx.001	449.45556	460.9	1.0254629	P
CY.N.SFH.03.Gen.ReEx.001	85.00000	180.0	2.1176471	P
CY.N.SFH.04.Gen.ReEx.001	85.00000	180.0	2.1176471	P
SI.N.AB.01.Gen.ReEx.001	202.07692	220.0	1.0886943	P
SI.N.AB.06.Gen.ReEx.001	466.61538	1341.0	2.8738872	P
SI.N.MFH.01.Gen.ReEx.001	290.00000	297.0	1.0241379	P
SI.N.MFH.02.Gen.ReEx.001	42.19231	283.0	6.7073838	P
SI.N.MFH.06.Gen.ReEx.001	462.75000	395.1	0.8538088	P
SI.N.SFH.01.Gen.ReEx.001	75.50000	226.0	2.9933775	P
SI.N.SFH.03.Gen.ReEx.001	90.50000	89.2	0.9856354	P
SI.N.SFH.04.Gen.ReEx.001	56.60000	113.2	2.0000000	P
SI.N.SFH.05.Gen.ReEx.001	95.00000	104.2	1.0968421	P
SI.N.SFH.06.Gen.ReEx.001	143.50000	129.6	0.9031359	P
SI.N.TH.02.Gen.ReEx.001	74.65000	64.0	0.8573342	P
SI.N.TH.04.Gen.ReEx.001	234.00000	145.8	0.6230769	P

removed cases A_Floor (continuation)

Code_Building	A_C_Storey	A_Floor	A_Floor/A_C_Storey	Corr
SI.N.TH.05.Gen.ReEx.001	174.00000	161.2	0.9264368	P
SI.N.TH.06.Gen.ReEx.001	188.00000	100.2	0.5329787	P
IE.N.SFH.01.325SB.ReEx.001	89.75000	89.8	1.0005571	P
IE.N.SFH.03.Gen.ReEx.001	105.00000	115.5	1.1000000	P
IE.N.TH.03.Gen.ReEx.001	40.50000	43.8	1.0814815	P
IE.N.SFH.04.Gen.ReEx.001	141.10000	154.4	1.0942594	P
IE.N.SFH.05.Gen.ReEx.001	115.10000	125.0	1.0860122	P
IE.N.TH.06.Gen.ReEx.001	41.60000	45.6	1.0961538	P
IE.N.SFH.06.HBlock.ReEx.001	141.70000	87.7	0.6189132	P
IE.N.TH.09.Gen.ReEx.001	56.55000	61.7	1.0910698	P
IE.N.AB.06.Gen.ReEx.001	360.00000	372.5	1.0347222	P
IE.N.AB.07.Gen.ReEx.001	156.64000	164.8	1.0520940	P
HU.N.AB.02.Ind.ReEx.001	398.25000	398.3	1.0001255	P
HU.N.AB.03.Ind.ReEx.001	375.20000	375.2	1.0000000	P
HU.N.AB.05.Gen.ReEx.001	340.40000	340.3	0.9997062	P
HU.N.MFH.01.Gen.ReEx.001	442.66667	443.6	1.0021084	P
HU.N.MFH.02.Gen.ReEx.001	279.33333	280.0	1.0023866	P
HU.N.MFH.03.Gen.ReEx.001	170.50000	114.0	0.6686217	P
HU.N.MFH.04.Gen.ReEx.001	170.00000	114.0	0.6705882	P
HU.N.MFH.05.Gen.ReEx.001	124.33333	124.0	0.9973190	P
HU.N.SFH.01.Bel80.ReEx.001	56.00000	56.0	1.0000000	P
HU.N.SFH.01.Gen.ReEx.001	101.80000	101.8	1.0000000	P
HU.N.SFH.02.Bel80.ReEx.001	59.40000	59.4	1.0000000	P
HU.N.SFH.02.Gen.ReEx.001	115.60000	115.6	1.0000000	P
HU.N.SFH.05.Gen.ReEx.001	65.80000	131.6	2.0000000	P
AT.N.SFH.04.Gen.ReEx.001	48.42105	143.8	2.9697826	P
AT.N.SFH.05.Gen.ReEx.001	59.30000	59.3	1.0000000	P
AT.N.TH.02.Gen.ReEx.001	124.50000	103.8	0.8337349	P
AT.N.TH.04.Gen.ReEx.001	59.20000	52.5	0.8868243	P
AT.N.TH.07.Gen.ReEx.001	72.40000	60.4	0.8342541	P
AT.N.MFH.05.Gen.ReEx.001	131.02222	263.6	2.0118725	P
AT.N.AB.07.Gen.ReEx.001	181.24000	380.8	2.1010814	P
AT.N.AB.08.Gen.ReEx.001	181.24000	380.8	2.1010814	P
CZ.N.SFH.02.Gen.ReEx.001	45.77143	42.8	0.9350811	P
CZ.N.SFH.03.Gen.ReEx.001	76.22857	67.0	0.8789355	P
CZ.N.MFH.06.Gen.ReEx.001	469.02500	502.1	1.0705186	P
FR.N.AB.01.Gen.ReEx.001	244.67143	570.0	2.3296549	P
FR.N.SFH.03.Gen.ReEx.001	39.35000	89.1	2.2642948	P
FR.N.SFH.04.Gen.ReEx.001	34.07273	100.8	2.9583778	P
FR.N.TH.04.Gen.ReEx.001	57.75000	63.0	1.0909091	P
FR.N.TH.05.Gen.ReEx.001	82.50000	80.7	0.9781818	P
FR.N.AB.06.Gen.ReEx.001	669.68000	724.4	1.0817107	P
FR.N.SFH.07.Gen.ReEx.001	106.80000	107.0	1.0018727	P
FR.N.SFH.08.Gen.ReEx.001	122.10000	51.4	0.4209664	P
FR.N.MFH.08.Gen.ReEx.001	497.20000	150.7	0.3030973	P
FR.N.SFH.09.Gen.ReEx.001	104.50000	57.0	0.5454545	P
FR.N.TH.09.Gen.ReEx.001	73.70000	80.0	1.0854817	P
FR.N.MFH.09.Gen.ReEx.001	198.00000	206.6	1.0434343	P
NL.N.SFH.05.Gen.ReEx.001	67.81818	61.5	0.9068365	P
NL.N.SFH.05.Semi.ReEx.001	59.09091	52.3	0.8850769	P
NL.N.TH.04.Gen.ReEx.001	62.70000	56.0	0.8931419	P
NL.N.TH.05.Gen.ReEx.001	49.70909	45.5	0.9153255	P
NL.N.TH.04.End.ReEx.001	62.70000	56.0	0.8931419	P
NL.N.TH.05.End.ReEx.001	49.70909	45.5	0.9153255	P
NL.N.AB.01.Gal.ReEx.001	712.80000	648.0	0.9090909	P
NL.N.AB.02.Gen.ReEx.001	721.60000	656.0	0.9090909	P
NL.N.AB.03.Gal.ReEx.001	374.00000	340.0	0.9090909	P
NL.N.AB.04.Gen.ReEx.001	521.40000	474.0	0.9090909	P
NL.N.AB.05.Gen.ReEx.001	808.77500	729.1	0.9014868	P
NL.N.AB.01.Por1945.ReEx.001	843.70000	767.0	0.9090909	P
NL.N.AB.01.Gen.ReEx.001	508.20000	462.0	0.9090909	P
NL.N.AB.02.Por.ReEx.001	390.50000	355.0	0.9090909	P
NL.N.AB.03.Gen.ReEx.001	385.00000	350.0	0.9090909	P
NL.N.AB.04.Por.ReEx.001	488.40000	444.0	0.9090909	P
NL.N.AB.01.Mai.ReEx.001	338.80000	239.4	0.7066116	P
NL.N.AB.02.Mai.ReEx.001	338.80000	296.1	0.8739669	P
NL.N.AB.03.Mai.ReEx.001	308.00000	250.6	0.8136364	P
NL.N.AB.04.Mai.ReEx.001	184.80000	159.2	0.8614719	P
NL.N.MFH.01.Gen.ReEx.001	515.90000	469.0	0.9090909	P
NL.N.MFH.02.Gen.ReEx.001	423.50000	385.0	0.9090909	P
NL.N.MFH.03.Gen.ReEx.001	385.00000	350.0	0.9090909	P
NL.N.MFH.04.Gen.ReEx.001	360.80000	328.0	0.9090909	P
NL.N.MFH.05.Gen.ReEx.001	757.97500	586.6	0.7739042	P
NL.N.SFH.06.Gen.ReEx.001	67.81818	61.5	0.9068365	P
NL.N.SFH.06.Semi.ReEx.001	59.09091	52.3	0.8850769	P
NL.N.TH.06.Gen.ReEx.001	49.70909	45.5	0.9153255	P
NL.N.TH.06.End.ReEx.001	49.70909	45.5	0.9153255	P
NL.N.AB.06.Gen.ReEx.001	808.77500	729.1	0.9014868	P
NL.N.MFH.06.Gen.ReEx.001	757.97500	586.6	0.7739042	P


Number of cases: 595 without data correction
Percent of Total
0
5
10
15
20
25
30
35
40
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
A_Roof / A_C_Storey


Number of cases: 472 AFTER data correction
Percent of Total
0
5
10
15
20
25
30
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
A_Roof / A_C_Storey

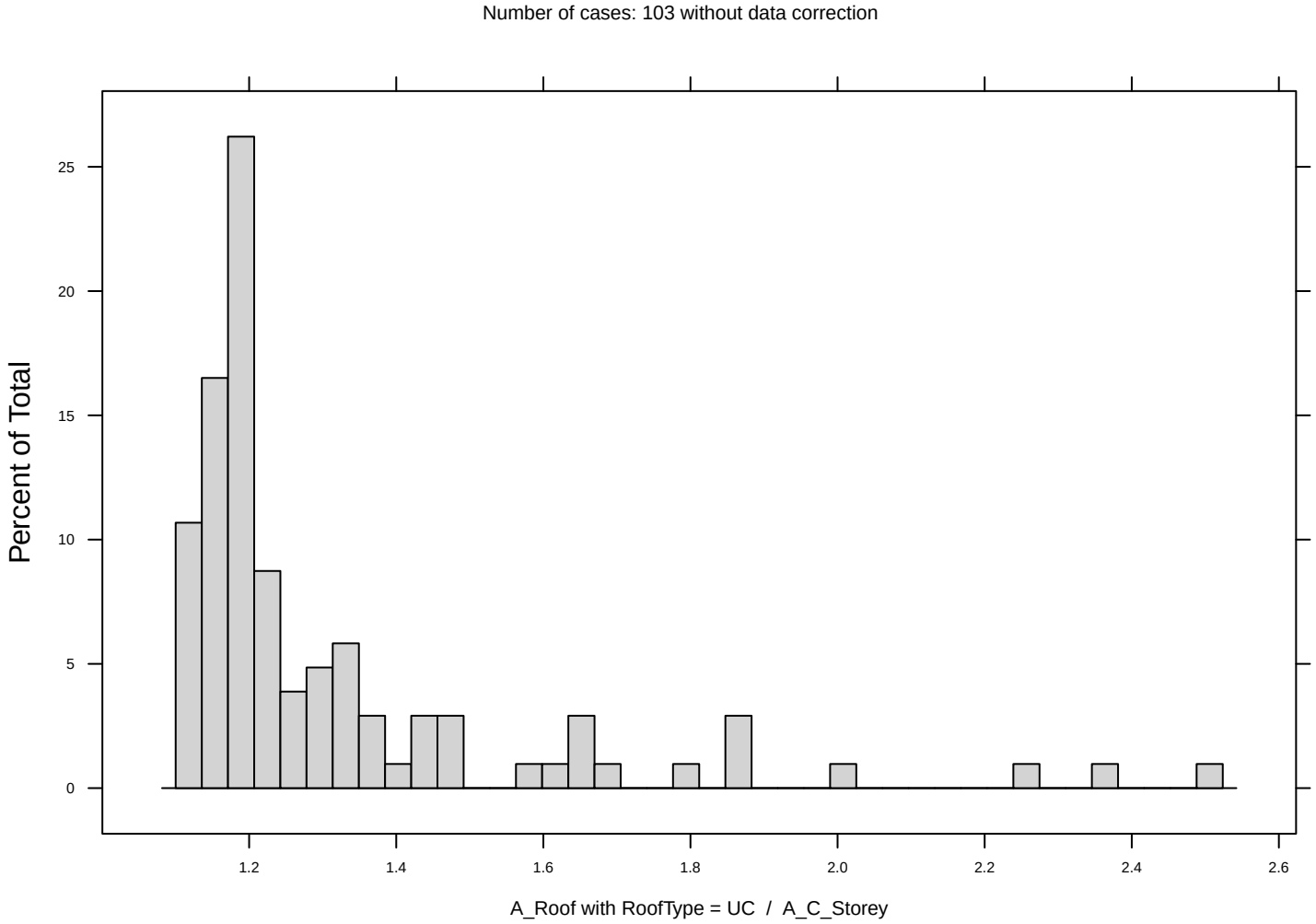
removed cases A_Roof

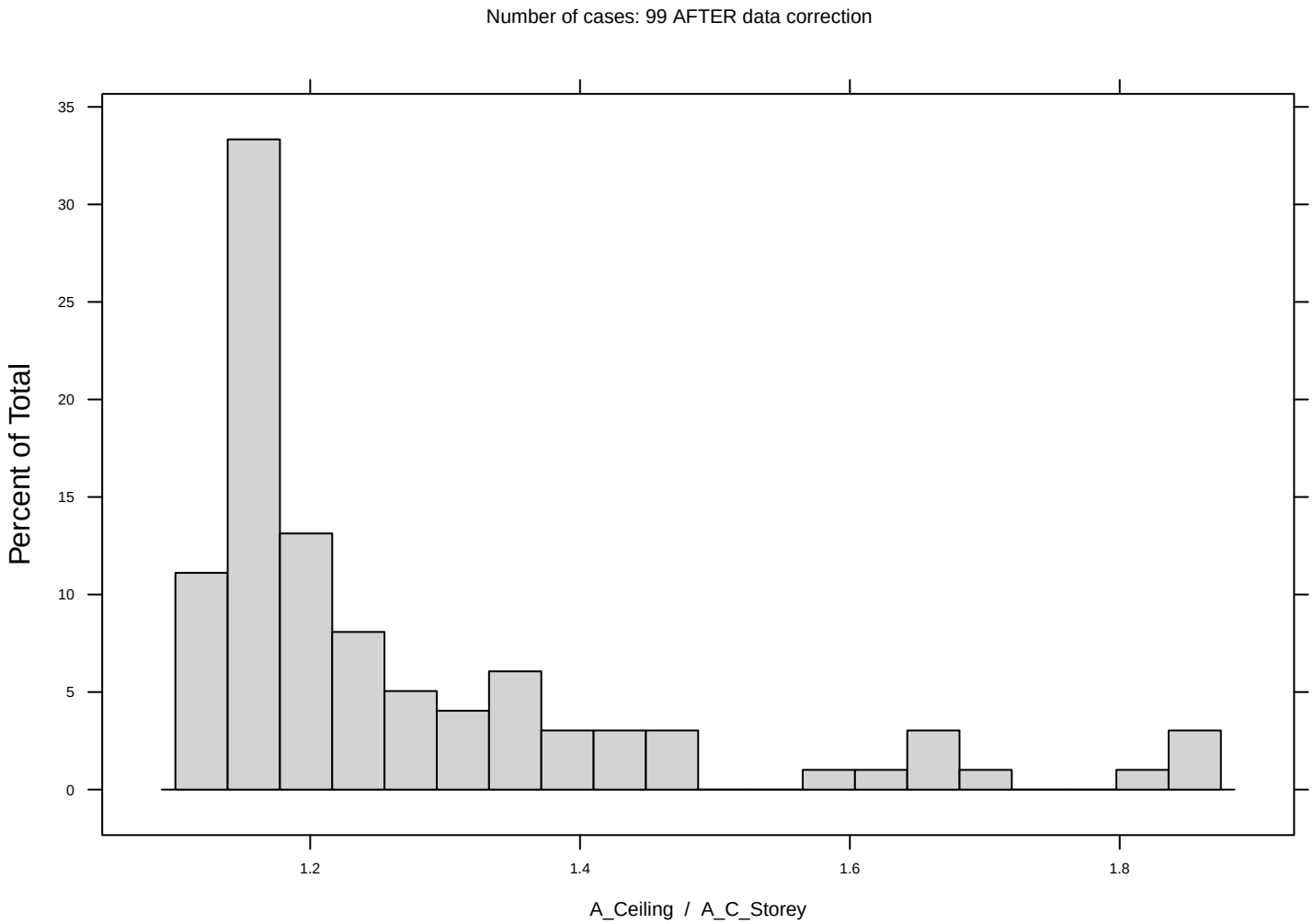
Code_Building	A_C_Storey	A_Roof	A_Roof/A_C_Storey	Corr
FR.N.SFH.04.Gen.ReEx.001	34.07273	128.0	3.7566702	Out
BG.N.MFH.02.Gen.ReEx.001	95.20000	287.0	3.0147059	Out
SI.N.SFH.01.Gen.ReEx.001	75.50000	226.0	2.9933775	Out
AT.N.SFH.04.Gen.ReEx.001	48.42105	143.8	2.9697826	Out
SI.N.AB.06.Gen.ReEx.001	466.61538	1341.0	2.8738872	Out
GR.ZoneD.SFH.03.Gen.ReEx.001	55.25000	150.0	2.7149321	Out
RS.N.TH.07.Gen.ReEx.001	41.77778	112.3	2.6880319	Out
AT.N.TH.04.Gen.ReEx.001	59.20000	156.9	2.6503378	Out
DE.N.SFH.06.Gen.ReEx.001	173.30000	183.1	1.0565493	P
DE.N.TH.03.Gen.ReEx.001	56.40000	50.4	0.8936170	P
DE.N.TH.04.Gen.ReEx.001	74.80000	81.2	1.0855615	P
DE.N.TH.05.Gen.ReEx.001	58.70000	46.2	0.7870528	P
DE.N.TH.11.Gen.ReEx.001	71.20000	75.7	1.0632022	P
DE.N.TH.12.Gen.ReEx.001	71.20000	75.7	1.0632022	P
DE.N.MFH.08.Gen.ReEx.001	259.36667	249.4	0.9615731	P
DE.N.MFH.10.Gen.ReEx.001	648.91852	580.0	0.8937948	P
DE.N.AB.05.Gen.ReEx.001	485.92500	479.6	0.9869836	P
DE.N.AB.05.HR.ReEx.001	715.55000	501.2	0.7004402	P
DE.N.AB.06.HR.ReEx.001	1415.22857	1469.0	1.0379949	P
XX.N.SFH.01.Gen.ReEx.001	75.42857	83.1	1.1017045	P
XX.N.SFH.02.Gen.ReEx.001	75.42857	83.1	1.1017045	P
XX.N.SFH.03.Gen.ReEx.001	75.42857	83.1	1.1017045	P
XX.N.MFH.01.Gen.ReEx.001	1666.50000	501.2	0.3007501	P
XX.N.MFH.02.Gen.ReEx.001	1666.50000	501.2	0.3007501	P
XX.N.MFH.03.Gen.ReEx.001	1666.50000	501.2	0.3007501	P
BG.N.MFH.01.Gen.ReEx.001	383.35000	373.0	0.9730012	P
BG.N.MFH.03.Gen.ReEx.001	212.50000	187.0	0.8800000	P
BG.N.MFH.02.Class.ReEx.001	276.26667	184.0	0.6660232	P
BE.N.SFH.01.Gen.ReEx.001	172.14545	157.4	0.9143431	P
BE.N.TH.01.Gen.ReEx.001	80.84211	81.1	1.0031901	P
BE.N.SFH.02.Gen.ReEx.001	145.74545	157.5	1.0806512	P
BE.N.TH.02.Gen.ReEx.001	71.15789	81.5	1.1453402	P
BE.N.SFH.03.Gen.ReEx.001	147.41818	169.2	1.1477553	P
BE.N.TH.03.Gen.ReEx.001	60.25263	71.2	1.1816911	P
BE.N.SFH.04.Gen.ReEx.001	159.70909	160.4	1.0043260	P
BE.N.TH.04.Gen.ReEx.001	68.54737	75.1	1.0955928	P
BE.N.SFH.05.Gen.ReEx.001	166.69091	152.3	0.9136671	P
BE.N.TH.05.Gen.ReEx.001	71.53684	68.2	0.9533549	P
BE.N.SFH.06.Gen.ReEx.001	166.69091	152.3	0.9136671	P
BE.N.TH.06.Gen.ReEx.001	71.53684	68.2	0.9533549	P
RS.N.MFH.04.Gen.ReEx.001	230.00000	237.0	1.0304348	P
RS.N.SFH.08.Gen.ReEx.001	103.66667	88.2	0.8508039	P
GR.ZoneD.SFH.04.Gen.ReEx.001	111.30000	114.4	1.0278527	P
DK.N.AB.04.Gen.ReEx.001	155.95000	163.0	1.0452068	P
GB.ENG.TH.01.Gen.ReEx.001	52.30000	56.4	1.0783939	P
GB.ENG.TH.07.Gen.ReEx.001	49.20000	47.3	0.9613821	P
GB.ENG.TH.08.Gen.ReEx.001	49.20000	47.3	0.9613821	P
GB.ENG.MFH.01.Gen.ReEx.001	141.66667	149.1	1.0524706	P
GB.ENG.MFH.02.Gen.ReEx.001	160.26667	168.2	1.0495008	P
GB.ENG.MFH.03.Gen.ReEx.001	149.03333	156.7	1.0514426	P
GB.ENG.MFH.04.Gen.ReEx.001	186.46667	195.0	1.0457633	P
GB.ENG.MFH.05.Gen.ReEx.001	211.03333	220.1	1.0429632	P
GB.ENG.MFH.06.Gen.ReEx.001	230.86667	240.3	1.0408605	P
GB.ENG.MFH.07.Gen.ReEx.001	331.46667	342.8	1.0341915	P
GB.ENG.MFH.08.Gen.ReEx.001	331.46667	342.8	1.0341915	P
GB.ENG.AB.03.Gen.ReEx.001	305.60909	316.5	1.0356367	P
GB.ENG.AB.04.Gen.ReEx.001	335.16154	360.1	1.0744073	P
GB.ENG.AB.07.Gen.ReEx.001	449.45556	460.9	1.0254629	P
SI.N.AB.01.Gen.ReEx.001	202.07692	220.0	1.0886943	P
SI.N.MFH.01.Gen.ReEx.001	290.00000	303.0	1.0448276	P
SI.N.MFH.02.Gen.ReEx.001	42.19231	283.0	6.7073838	P
SI.N.MFH.05.Gen.ReEx.001	330.85000	246.2	0.7441439	P
SI.N.MFH.06.Gen.ReEx.001	462.75000	417.8	0.9028633	P
SI.N.SFH.03.Gen.ReEx.001	90.50000	91.7	1.0132597	P
SI.N.SFH.05.Gen.ReEx.001	95.00000	69.1	0.7273684	P
SI.N.SFH.06.Gen.ReEx.001	143.50000	126.4	0.8808362	P
SI.N.TH.04.Gen.ReEx.001	234.00000	133.2	0.5692308	P
SI.N.TH.05.Gen.ReEx.001	174.00000	162.7	0.9350575	P
SI.N.TH.06.Gen.ReEx.001	188.00000	104.2	0.5542553	P
IE.N.TH.02.Gen.ReEx.001	66.00000	71.7	1.0863636	P
IE.N.TH.03.Gen.ReEx.001	40.50000	43.8	1.0814815	P
IE.N.SFH.05.Gen.ReEx.001	115.10000	125.0	1.0860122	P
IE.N.TH.06.Gen.ReEx.001	41.60000	45.6	1.0961538	P
IE.N.SFH.06.HBlock.ReEx.001	141.70000	87.7	0.6189132	P
IE.N.TH.09.Gen.ReEx.001	56.55000	61.7	1.0910698	P
IE.N.AB.07.Gen.ReEx.001	156.64000	164.8	1.0520940	P
HU.N.AB.02.Ind.ReEx.001	398.25000	398.3	1.0001255	P
HU.N.AB.03.Ind.ReEx.001	375.20000	375.2	1.0000000	P
HU.N.AB.05.Gen.ReEx.001	340.40000	340.3	0.9997062	P
HU.N.MFH.01.Gen.ReEx.001	442.66667	443.6	1.0021084	P
HU.N.MFH.02.Gen.ReEx.001	279.33333	280.0	1.0023866	P
HU.N.MFH.03.Gen.ReEx.001	170.50000	131.9	0.7736070	P
HU.N.MFH.04.Gen.ReEx.001	170.00000	131.9	0.7758824	P
HU.N.SFH.01.Bel80.ReEx.001	56.00000	56.0	1.0000000	P
HU.N.SFH.01.Gen.ReEx.001	101.80000	101.8	1.0000000	P
HU.N.SFH.02.Bel80.ReEx.001	59.40000	59.4	1.0000000	P
HU.N.SFH.02.Gen.ReEx.001	115.60000	115.6	1.0000000	P
AT.N.SFH.05.Gen.ReEx.001	59.30000	59.3	1.0000000	P
AT.N.TH.02.Gen.ReEx.001	124.50000	118.5	0.9518072	P
AT.N.TH.07.Gen.ReEx.001	72.40000	65.8	0.9088398	P

removed cases A_Roof (continuation)

Code_Building	A_C_Storey	A_Roof	A_Roof/A_C_Storey	Corr
CZ.N.SFH.03.Gen.ReEx.001	76.22857	72.2	0.9471514	P
CZ.N.MFH.06.Gen.ReEx.001	469.02500	502.1	1.0705186	P
FR.N.TH.04.Gen.ReEx.001	57.75000	63.0	1.0909091	P
FR.N.MFH.04.Gen.ReEx.001	114.95000	120.0	1.0439321	P
FR.N.TH.05.Gen.ReEx.001	82.50000	80.7	0.9781818	P
FR.N.SFH.06.Gen.ReEx.001	47.96667	34.0	0.7088256	P
FR.N.AB.06.Gen.ReEx.001	669.68000	724.4	1.0817107	P
FR.N.SFH.07.Gen.ReEx.001	106.80000	107.0	1.0018727	P
FR.N.SFH.08.Gen.ReEx.001	122.10000	51.7	0.4234234	P
FR.N.MFH.08.Gen.ReEx.001	497.20000	150.7	0.3030973	P
FR.N.SFH.09.Gen.ReEx.001	104.50000	57.0	0.5454545	P
FR.N.MFH.09.Gen.ReEx.001	198.00000	206.6	1.0434343	P
NL.N.SFH.05.Semi.ReEx.001	59.09091	69.9	1.1829231	P
NL.N.TH.04.Gen.ReEx.001	62.70000	56.1	0.8947368	P
NL.N.TH.04.End.ReEx.001	62.70000	56.1	0.8947368	P
NL.N.AB.01.Gal.ReEx.001	712.80000	675.0	0.9469697	P
NL.N.AB.02.Gen.ReEx.001	721.60000	713.4	0.9886364	P
NL.N.AB.03.Gal.ReEx.001	374.00000	340.0	0.9090909	P
NL.N.AB.04.Gen.ReEx.001	521.40000	523.6	1.0042194	P
NL.N.AB.05.Gen.ReEx.001	808.77500	729.1	0.9014868	P
NL.N.AB.01.Por1945.ReEx.001	843.70000	820.3	0.9722650	P
NL.N.AB.01.Gen.ReEx.001	508.20000	501.9	0.9876033	P
NL.N.AB.02.Por.ReEx.001	390.50000	375.5	0.9615877	P
NL.N.AB.03.Gen.ReEx.001	385.00000	409.5	1.0636364	P
NL.N.AB.04.Por.ReEx.001	488.40000	492.0	1.0073710	P
NL.N.MFH.01.Gen.ReEx.001	515.90000	497.7	0.9647218	P
NL.N.MFH.02.Gen.ReEx.001	423.50000	409.5	0.9669421	P
NL.N.MFH.03.Gen.ReEx.001	385.00000	375.0	0.9740260	P
NL.N.MFH.04.Gen.ReEx.001	360.80000	352.8	0.9778271	P
NL.N.MFH.05.Gen.ReEx.001	757.97500	586.6	0.7739042	P
NL.N.SFH.06.Semi.ReEx.001	59.09091	69.9	1.1829231	P
NL.N.AB.06.Gen.ReEx.001	808.77500	729.1	0.9014868	P
NL.N.MFH.06.Gen.ReEx.001	757.97500	586.6	0.7739042	P

A_Roof / RoofType!=UC no correction required

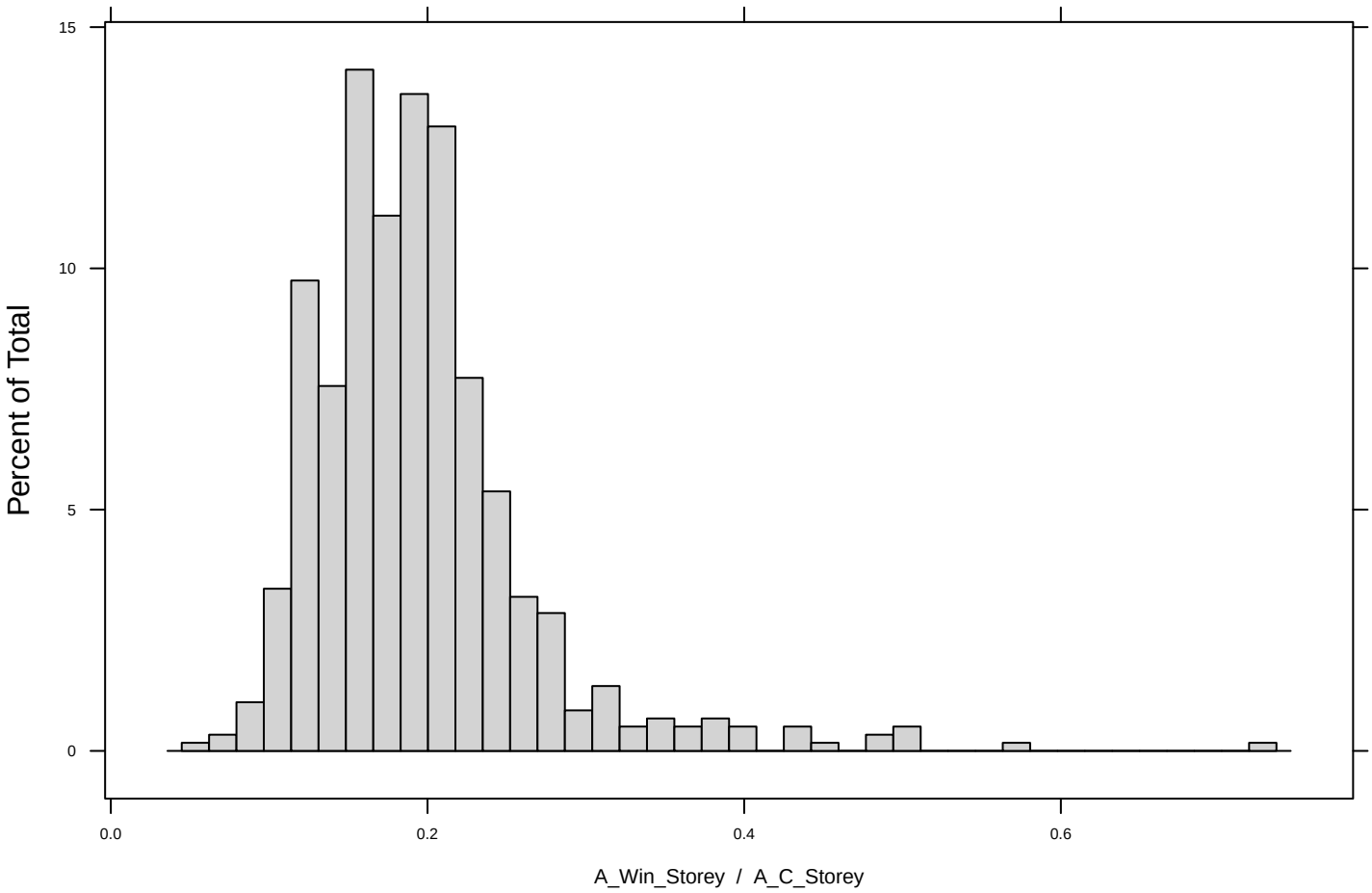

Number of cases: 103 without data correction
Percent of Total
0
5
10
15
20
25
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
A_Roof with RoofType = UC / A_C_Storey


Number of cases: 99 AFTER data correction
Percent of Total
0
5
10
15
20
25
30
35
1.2
1.4
1.6
1.8
A_Ceiling / A_C_Storey

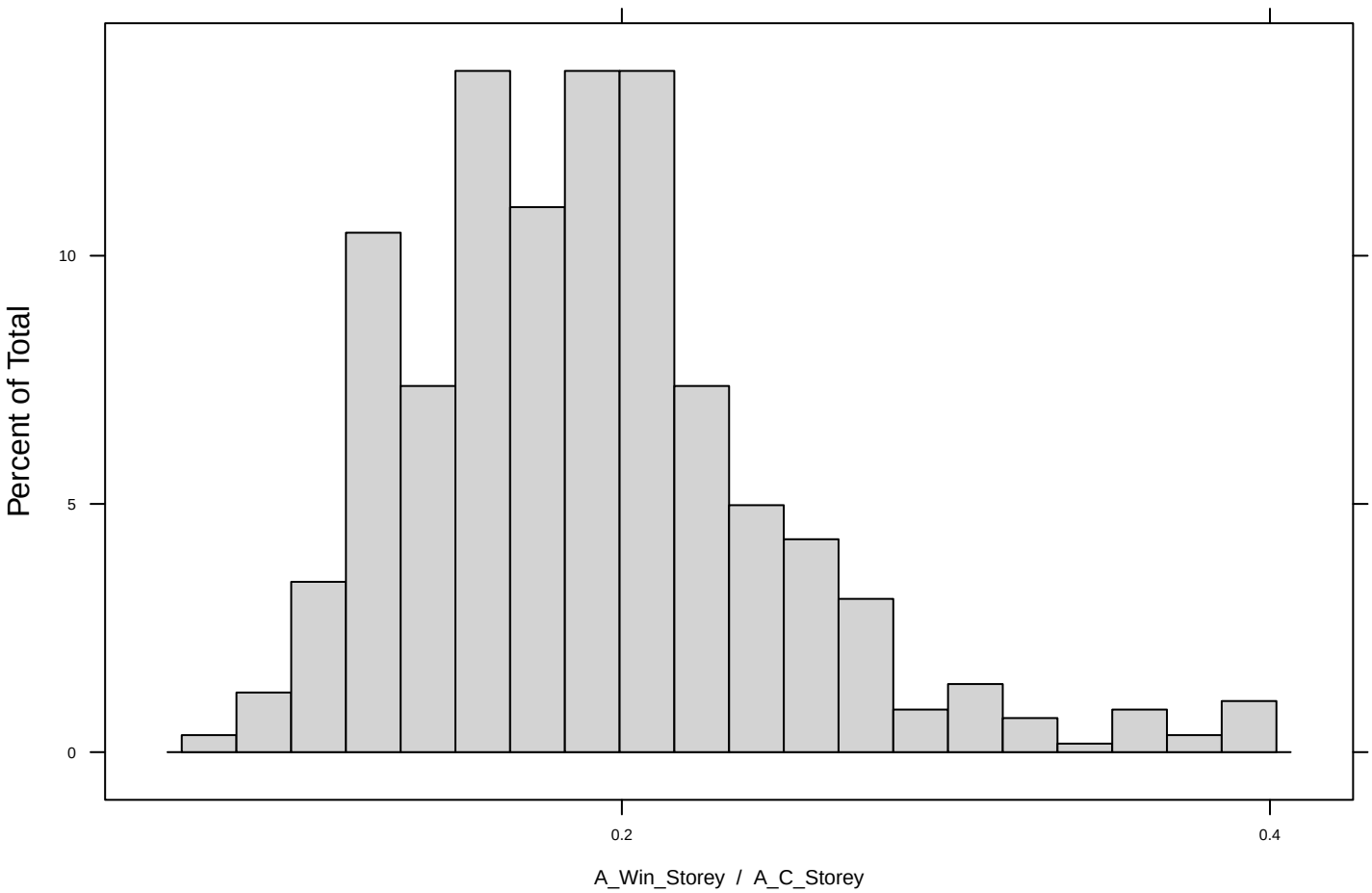
removed cases A_Roof / RoofType=UC

Code_Building	A_C_Storey	A_Ceiling	A_Ceiling/A_C_Storey	Corr
BG.N.SFH.01.Gen.ReEx.001	52.70	133.0	2.523719	Out
BG.N.TH.01.Gen.ReEx.001	67.80	161.0	2.374631	Out
RS.N.SFH.04.Gen.ReEx.001	36.25	82.0	2.262069	Out
HU.N.SFH.05.Gen.ReEx.001	65.80	131.6	2.000000	Out

Number of cases: 595 without data correction

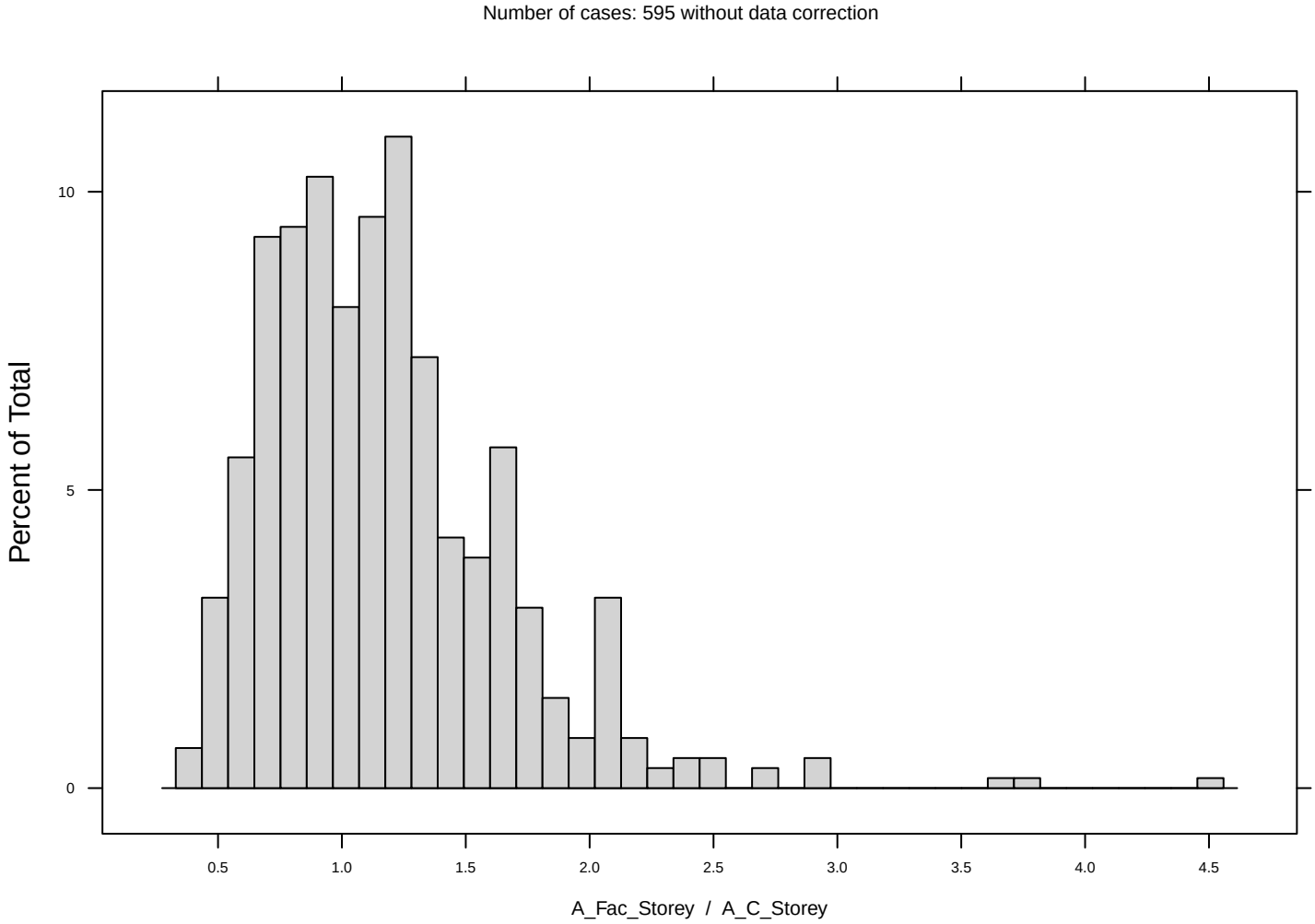


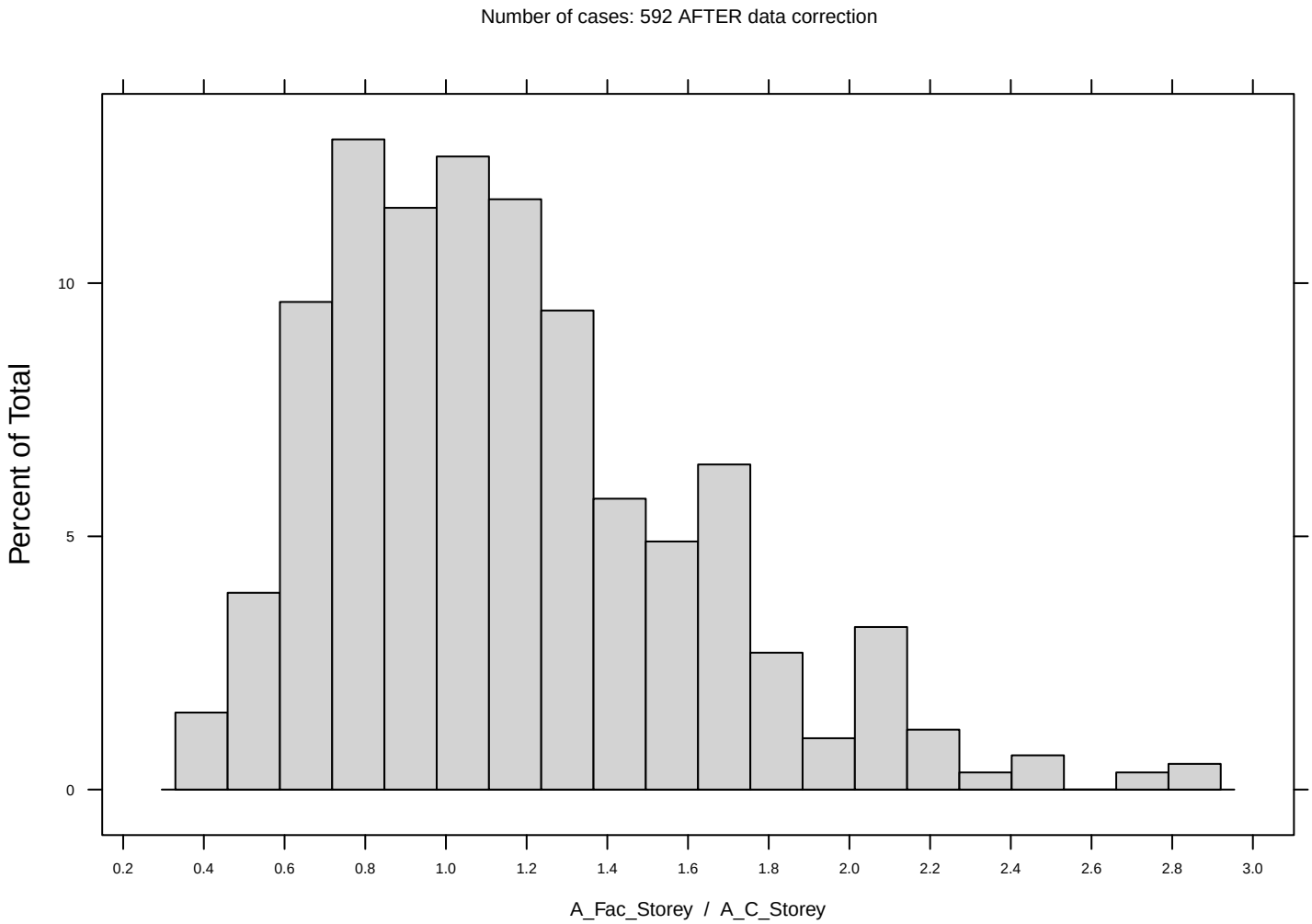
Number of cases: 583 AFTER data correction



removed cases A_Window per effective storey

Code_Building	A_Window/A_C_Ref	A_C_Storey	A_Win_Storey	A_C_Ref	A_Window	Corr
FR.N.TH.09.Gen.ReEx.001	0.04477612			73.7	3.3	P
BG.N.TH.02.Class.ReEx.001	0.43238660	157.2667	68.00000			Out
DK.N.TH.05.Gen.ReEx.001	0.43473193	42.9000	18.65000			Out
BE.N.AB.03.Gen.ReEx.001	0.44130719	1147.5000	506.40000			Out
BE.N.MFH.04.Gen.ReEx.001	0.44393515	196.3500	87.16667			Out
BE.N.AB.05.Gen.ReEx.001	0.49102793	306.0000	150.25455			Out
BE.N.AB.06.Gen.ReEx.001	0.49102793	306.0000	150.25455			Out
SI.N.SFH.01.Gen.ReEx.001	0.49668874	75.5000	37.50000			Out
RS.N.AB.04.Gen.ReEx.001	0.49736842	190.0000	94.50000			Out
GR.ZoneD.SFH.01.Gen.ReEx.001	0.49774920	77.7500	38.70000			Out
BG.N.MFH.02.Gen.ReEx.001	0.57773109			190.4	110.0	P
BE.N.MFH.02.Gen.ReEx.001	0.73614801			2108.0	1551.8	P


Number of cases: 595 without data correction
Percent of Total
0
5
10
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
A_Fac_Storey / A_C_Storey


Number of cases: 592 AFTER data correction
Percent of Total
0
5
10
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
A_Fac_Storey / A_C_Storey

removed cases A_Facade (A_Wall+A_Window) per effective storey

Code_Building	A_C_Storey	A_Fac_Storey	A_Facade/A_C_Ref	Corr
BG.N.MFH.02.Gen.ReEx.001	95.2	434.00	4.558824	Out
CY.N.TH.01.Gen.ReEx.001	50.0	187.55	3.751000	Out
CY.N.SFH.02.Gen.ReEx.001	111.5	410.20	3.678924	Out