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– The Energy Consumption Component –

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ITC	Industry, trade and commerce
MFH	Multifamily houses
SFH	Single-family houses

1. Introduction

The Energy Consumption Component aims to convert annual energy consumption data for heat, electricity, and gas with at municipal level to the temporal and spatial resolution of one hour and 100m.

2. General Equations

Three forms of energy consumption are determined in separate models for different consumer types: electrical energy, heat, and gas.

The basic input needed for the determination of the energy consumption is number of residential buildings as well as the industry, trade, and commerce buildings. The distribution of the buildings is read in for one reference year and then updated annually by incorporating the newly constructed and demolished buildings.

2.1 The electrical energy consumption model

For the calculation of the hourly load profiles, three consumer types of electrical energy consumption are distinguished:

1) Residential buildings
2) Industry, trade, and commerce (ITC) buildings
3) Miscellaneous like street lightening

The annual electricity consumption per building is first read in on pixel scale for one reference year (see chapter 4). The changes in the annual consumption are incorporated annually according to Equation (1) on municipal scale. The factor $\Delta E_{B,a}$ is hereby defined as the increase respectively decrease of the annual electrical energy consumption of the current simulation year compared to the consumption in the reference year and dependent on the municipality.

$$E_{B,a}(CT) = E_{B,R}(CT) \cdot \Delta E_{B,a}(CT) \quad (1)$$

with:

$E_{B,a}$	=	*Annual electrical energy consumption of the consumer type at simulation year a*	*[kWh]*
CT	=	*Consumer type (1 – Residential buildings, 2 – ITC buildings)*	*[-]*
$E_{B,R}$	=	*Annual electrical energy consumption of the consumer type at reference year R*	*[kWh]*
$\Delta E_{B,a}$	=	*Change of the energy consumption of year a to reference year R*	*[-]*

The annual electrical energy consumption is converted to an hourly resolution based on hourly load profiles described in Table A 1 and Table A 2. The determination of the electrical consumption for the

two consumer types residential buildings, and ITC buildings is shown in Equation (2). Consumer type 1 uses the load profiles for households and consumer type 2 uses the profile for business. Three seasons of winter (1.11. – 20.3.), summer (15.5. – 14.9.), and spring / autumn (21.3. – 14.5. and 15.9. – 31.10.) are differentiated and three different daily profiles for Saturday, Sunday and working days are applied. Public holidays are covered by the Sunday profile.

$$E_{B,h}(CT) = E_{B,a}(CT) \cdot n_B(CT) \cdot f_E(CT, S, doW) \quad (2)$$

with:

$E_{B,h}$	=	*Hourly electrical energy demand from the consumer type on the pixel*	*[kWh]*
n_{BB}	=	*Number of buildings per pixel*	*[-]*
f_E	=	*Load factor for electrical energy*	*[-]*
S	=	*Type of Season*	*[-]*
doW	=	*Type of day*	*[-]*

The hourly electrical energy consumption of miscellaneous is calculated according to Equation (3). The load factor is kept similar to the profile of category for households. Miscellaneous is considered as distributed equally over the municipality.

$$E_{Msc,h} = E_{Msc,a} \cdot f_E(CT, S, doW) \quad (3)$$

with:

$E_{Msc,h}$	=	*Hourly electrical energy demand from miscellaneous per pixel*	*[kWh]*
$E_{MscB,a}$	=	*Annual electrical energy consumption miscellaneous per pixel*	*[kWh]*
CT	=	*Consumer type Residential buildings*	*[-]*

2.2 The heat energy consumption model

The conversion of annual heat consumption to an hourly resolution is based on a guideline provided by BDEW (2016). Three consumer types are distinguished:

1) Single family houses (SFH)
2) Multifamily houses (MFH)
3) Industry, trade and commerce buildings (ITCB)

The heat consumption per pixel is calculated for single-family houses and multifamily houses using the number of residential buildings and the ratio between SFH and MFH, which are read in on municipal

scale. The number of main buildings is used for ITC buildings.

First, the daily heat demand for the three types of consumers is determined, depending on the weekday (Monday to Sunday) in the following steps:

The annual heat consumption per building is read in on pixel scale for one reference year (see chapter 4). The changes in the annual consumption are incorporated annually according to Equation (1) on municipal scale. The factor $\Delta H_{B,a}$ is hereby defined as the increase respectively decrease of the annual heat energy consumption of the current simulation year compared to the consumption in the reference year and dependent on the municipality.

$$H_{B,a}(CT) = H_{B,R}(CT) \cdot \Delta H_{B,a}(CT) \cdot n_B(CT) \tag{4}$$

with:

$H_{B,a}$	=	*Annual heat energy consumption of the consumer type at simulation year a*	*[kWh]*
CT	=	*Consumer type (1 – Single family houses, 2 – multifamily houses, 3 – ITC buildings)*	*[-]*
$H_{B,R}$	=	*Annual heat energy consumption of the consumer type at reference year R*	*[kWh]*
$\Delta H_{B,a}$	=	*Change of the energy consumption of year a to reference year R*	*[-]*
n_B	=	*Number of buildings per pixel*	*[-]*

The *KW* value is calculated according to Equation (5), which is defined as the mean daily heat consumption at a temperature of 8 °C. The h_s-factor is part of the input as explained in chapter 4.

$$KW_H(CT) = \frac{H_{B,a}(CT)}{h_s(CT)} \tag{5}$$

with:

KW_H	=	*Normalized daily heat consumption*	*[kWh]*
h_s	=	*Annual sum of daily h-values*	*[-]*

Next, the *h* profile value is determined according to Equation (6), which depends on the air temperature of the last 24 hours and the consumer type. In contrast to the recommendations of BDEW (2016), the mean air temperature of the previous day is used for reasons of convenience. The parameterization of the profile coefficients is shown in Table 2-1.

$$h(CT,T) = \frac{A(CT)}{1 + \frac{B(CT)}{T - T_o}^{C(CT)}} + D(CT) + \max\begin{cases} mH(CT) \cdot T + bH(CT) \\ mW(CT) \cdot T + bW(CT) \end{cases} \tag{6}$$

with:

h	=	*h profile value*	*[-]*
CT	=	*Consumer type (1 – SFH, 2 –MFH, 3 – ITC buildings)*	*[-]*
T	=	*Average air temperature of the day before*	*[°C]*
A, B, C, D, mH, bH, mW, bW	=	*Profile coefficients*	*[-]*
T_0	=	*Reference temperature of 40 °C*	*[°C]*

Table 2-1: Profile coefficients for the determination of h(CT,T) for the three consumer types (Source: BDEW (2016))

Consumer type	A	B	C	D	mH	bH	mW	bW
SFH	1.6209544	-37.1833141	5.6727847	0.0716431	-0.04957	0.8401015	-0.002209	0.1074468
MFH	1.2328655	-34.7213605	5.8164304	0.0873352	-0.040928	0.767292	-0.002232	0.1199207
ITCB	1.3010623	-35.6816144	6.6857976	0.1409267	-0.047343	0.8141691	-0.0010601	0.1325092

The daily heat demand is determined by the normed heat consumption *KW*, the *h* profile value, and the factor FWt according to Equation (7). The parameterizations of the factors are listed in Table 2-2.

$$H_{B,D}(CT) = KW_H(CT) \cdot h(CT,T) \cdot FWt(CT,n) \quad (7)$$

with:

$H_{B,D}$	=	*Daily heat demand of the buildings on the pixel*	*[kWh]*
FWt	=	*Weekday factor*	*[-]*
n	=	*Day of the week*	*[-]*

Table 2-2: Parameterization of the factor FWt for weekday n and consumer type CT [-] (Source: BDEW (2016))

Weekday	1	2	3	4	5	6	7
SFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ITCB	1.03	1.03	1.02	1.03	1.01	0.93	0.95

Next, the hourly heat consumption of the buildings is calculation per pixel and consumer type according to Equation (8). The hourly heat consumption is influenced by the temperature factor TF, which is shown in Table A 3 for single-family houses and Table A 4 for multifamily houses. For ITC buildings the temperature factor is further influenced by the day of the week (see Table A 5).

$$H_{B,h}(CT) = H_{b,D}(CT) \cdot TF(T_{act}, h) \quad (8)$$

with:

$H_{B,h}$	=	*Hourly heat demand of the buildings on the pixel*	*[kWh]*
TF	=	*Hourly temperature factor*	*[-]*
h	=	*Current hour*	*[h]*
T_{act}	=	*Current temperature*	*[°C]*

2.3 The gas consumption model

Two modes for the determination of the hourly gas consumption are implemented in the energy consumption component: Mode 1 is applied when the bioenergy module is deactivated. In that case, the gas consumption is calculated from input data. Mode 2 is used when the gas consumption is calculated within the bioenergy module.

2.3.1 Mode 1: Predefined gas consumption

The determination of the hourly gas demand follows the approach of BDEW (2016). It also is distinguished between the gas consumption of multifamily houses, industry buildings, and public buildings.

The annual gas consumption for multifamily houses and industry buildings is determined by the reference gas consumption of each consumer type and the number of residential or main buildings.

$$G_{B,a}(CT) = G_{B,R}(CT) \cdot n_B(CT) \quad (9)$$

with:

$G_{B,a}$	=	*Annual gas consumption of the consumer type at simulation year a*	*[kWh]*
CT	=	*Consumer type (1 – Multifamily houses, 2 – Industry buildings)*	*[-]*
$G_{B,R}$	=	*Annual gas consumption of the consumer type at reference year R*	*[kWh]*
n_B	=	*Number of buildings per pixel*	*[-]*

The annual gas consumption for public buildings is distributed equally over the pixels of each municipality.

$$G_{B,a}(CT) = G_{B,R}(CT) \quad (10)$$

with:

$G_{B,a}$	=	*Annual gas consumption of the consumer type at simulation year a*	*[kWh]*
CT	=	*Consumer type (3 – Public buildings)*	*[-]*
$G_{B,R}$	=	*Annual gas consumption of the consumer type at reference year R*	*[kWh]*

The KW_G value is calculated according to Equation (5), based on the h_s value described in chapter 4.

$$KW_G(CT) = \frac{G_{B,a}(CT)}{h_s(CT)} \quad (11)$$

with:

KW_G	=	*Normed daily gas consumption*	*[kWh]*
$G_{B,a}$	=	*Annual gas consumption per building of the consumer type*	*[kWh]*
CT	=	*Consumer type (1 – Multifamily houses, 2 – Industry buildings, 3 – Public buildings)*	*[-]*

Similar to the determination of the daily heat demand shown in Equation (7) the daily gas demand is calculated from the normed heat consumption KW_G, the *h* profile value and the factor FWt. The parameterizations of the factors are listed in Table 2-2.

$$G_{B,D}(CT) = KW_G(CT) \cdot h(CT,T) \cdot FWt(CT,n) \quad (12)$$

with:

GB,D	=	Daily gas demand of the buildings on the pixel	[kWh]

The determination of the hourly gas demand is shown in Equation (13) using the hourly temperature factor given in Table A 4 for multifamily houses and Table A 5 for industry and public buildings.

$$G_{B,h}(CT) = G_{b,D}(CT) \cdot TF(T_{act}, h) \quad (13)$$

with:

$G_{B,h}$ = *Hourly gas demand of the buildings on the pixel* *[kWh]*

2.3.2 Mode 2: Simulated gas consumption

If the bioenergy module is activated, the hourly consumption of gas is calculated from the heat consumption for the three consumer types residential buildings, ITC buildings and gas plants. A detailed description of the determination for residential and ITC buildings, which have gas-fired central heating systems, is given in Technical Release No. 4 chapter 4.1.3. Technical Release No. 4 chapter 6 describes the model used for gas plants; the management of the gas plants is described in Technical Release No. 7 chapter 4.3.

3. Preprocessing

The number of residential and ITC buildings is taken from LDBV (2015). The residential buildings were selected by the attribute domestic buildings; the remaining main buildings were categorized as ITC buildings except churches, castles, and buildings under monumental protection.

3.1 Electrical energy consumption

The electrical energy consumption obtained on municipal scale from local energy suppliers is resolved to building scale using a top-down process. The annual consumption per municipality is divided by the number of buildings categorized as residential buildings and main buildings to obtain the energy consumption for consumer type 1 and 2. The electrical energy consumption for consumer type 3 is obtained by dividing the consumption data by the number of pixels, which are covered by the municipalities.

The hourly load profiles are taken from VDEW (STADTWERKE UNNA 2015) using the households data set H0 and the general business data set G0. The profiles are aggregated from a 15 min resolution to an hourly time step by averaging.

3.2 Heat energy consumption

The heat energy consumption obtained on municipal scale from local energy suppliers is disaggregated to building scale using a top-down process. The annual consumption per municipality is divided by the number of buildings categorized as residential buildings and main buildings to obtain the energy consumption per building. The share of single-family houses to multifamily houses is obtained from literature data (BAYLFSTAD 2011).

3.3 Gas consumption

If mode 1 is activated the gas consumption obtained on municipal scale from local energy suppliers is resolved to building scale using a top-down process. The annual consumption per municipality is divided by the number of buildings categorized as residential buildings and main buildings to obtain the energy consumption for consumer type 1 and 2. The electrical energy consumption for consumer type 3 is obtained by dividing the consumption per municipality by the number of pixels belonging to the municipality.

4. Input data and format

The input data required to run the Energy Consumption Component of PROMET consists of spatially distributed values and tables.

The spatially reference data are stored in one file in pic-Format containing the followings 13 Layers:

Table 4-1: Spatially distributed input data of the Energy Consumption Component

Input Parameter	Description	Unit	Data format
WG	Number of residential buildings on grid cell	[-]	real
NWG	Number of ITC buildings per grid cell	[-]	real
EWG	Annual electricity demand per residential building	kWh	Real
ENWG	Annual electricity demand per ITC building	kWh	real
ESO	Annual electricity demand of miscellaneous per grid cell	kWh	real
HNWG	Annual heat demand per ITC building	kWh	real
HSFH	Annual heat demand per single family house	kWh	real
HMFH	Annual heat demand per multifamily house	kWh	real
HSNWG	Annual sum of daily h_s values of ITC buildings	[-]	real
HSSFH	Annual sum of daily h_s values of single family houses	[-]	Real
HSMFH	Annual sum of daily h_s values of multifamily houses	[-]	Real
GMFH	Annual gas demand of multifamily houses	kWh	real

GNWG	**Annual gas demand of ITC buildings**	**kWh**	**real**
GPU	**Annual gas demand of public buildings per grid cell**	**kWh**	**real**
SSM	**Share of single family houses in relation to multifamily houses per municipality**	**[-]**	**real**

The input tables that are needed to drive the energy consumption models are described in Table 4-2.

Table 4-2: General Input files of the Energy Consumption Component

File name	Description
Wochentag.txt	**List containing the days and their types from 01.01.1970 to 31.12.2045 (1 – Monday, 2 – Tuesday, 3 – Wednesday, 4 – Thursday, 5 – Friday, 6 – Saturday, 7 – Sunday/Public holiday)**
Lastgang_strom_sommer.txt **Lastgang_strom_übergang.txt** **Lastgang_strom_winter.txt**	**Hourly load profiles f_E for the electrical energy consumption for three types of days and three consumer types**
FWT.txt	**Values of the FWT-parameter for the type of day, TICB, SFH, and MFH**
hFaktoren_Waerme_GHD.txt **hFaktoren_Waerme_EFH.txt** **hFaktoren_Waerme_MFH.txt**	**Hourly values of the FT-parameter for different temperatures and weekdays**

The input file for new and demolished buildings requires the keyword [ConsRate]:

Table 4-3: Description of the input-file for the new buildings

Input Parameters	Description	Unit	Data format
Year	**Year of construction**	**[-]**	**integer**
Pixel_row	**Row ID of the new buildings**	**[-]**	**integer**
Pixel_Col	**Colum ID of the new buildings**	**[-]**	**Integer**
No_WG	**Number of newly constructed / demolished residential buildings**	**[-]**	**Integer**
No_NWG	**Amount of newly constructed / demolished ITC buildings**	**[-]**	**integer**

Example setup for the input file of newly constructed and demolished residential and ITC buildings:

```
[ConsRate]
2015 226 587  0 1
2022 229 527 -1 1
2034 230 539  4 3
[end]
```

Figure 4-1: Example of the input file for the newly constructed and demolished buildings

The setup file for the annual changes of the electrical energy consumption is split into the following sections:

- [Elec_Ch_WG]:

Table 4-4: Description of the input-file for the changes in the annual electrical consumption, Section Elec_Ch_WG

Input Parameters	Description	Unit	Data format
No_Mun	**ID-number of the municipality**	**[-]**	**integer**
Ch(R – a)	**Changes in the annual electrical energy consumption from reference year R to simulation year a for consumer type 1**	**[-]**	**real**

- [Elec_Ch_NWG]:

Table 4-5: Description of the input-file for the changes in the annual electrical consumption, Section Elec_Ch_NWG

Input Parameters	Description	Unit	Data format
No_Mun	**ID-number of the municipality**	**[-]**	**integer**
Ch(R – a)	**Changes in the annual electrical energy consumption from reference year R to simulation year a for consumer type 2**	**[-]**	**real**

Example setup for the annual changes in the electrical energy consumption for three municipalities for the reference year and nine following years:

```
[Elec_Ch_WG]
1        1.00 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03
2        1.00 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03
3        1.00 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03
[end]

[Elec_Ch_NWG]
1        1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04
```

```
2        1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04
3        1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04 1.05 1.01 1.02 1.03 1.04
[end]
```

Figure 4-2: Example of the input file for the annual changes in the electrical energy consumption for consumer type 1 and 2

The setup file for the changes in the annual heat consumption follows a similar structure using the keywords [Heat_Ch_EFH] for single family houses, [Heat_Ch_MFH] for multifamily houses, and [Heat_Ch_NWG] for ITC buildings.

5. Output

The output parameters of the Energy Consumption Component are listed below including the unit.

Table 5-1: Output data of the Energy Consumption Component

Output Parameter	Description	Unit	Data format
EWG_H	Hourly electricity consumption of the residential buildings per grid cell	[kWh]	real
ENWG_H	Hourly electricity consumption of ITC buildings per grid cell	[kWh]	real
ESO_H	Hourly electricity consumption of the miscellaneous per grid cell (equally distributed over grid cells per municipality)	[kWh]	real
HNWG_H	Hourly heat consumption of ITC buildings per grid cell	[kWh]	real
HSFH_H	Hourly heat consumption of single family houses per grid cell	[kWh]	real
HMFH_H	Hourly heat consumption of multifamily buildings per grid cell	[kWh]	real
HWG_H	Total hourly heat consumption of residential buildings per grid cell	[kWh]	real
GWG_H	Hourly gas consumption of residential buildings per grid cell	[kWh]	real
GNWG_H	Hourly gas consumption of ITC buildings per the grid cell	[kWh]	real
GPUB_H	Hourly gas consumption of public buildings (mode 1)/Gas plants (mode 2) per grid cell (equally distributed over grid cells per municipality for mode 1)	[kWh]	real

References

BDEW, VKU, GEODE 2016: BDEW\VKU\GEODE-Leitfaden. Abwicklung von Standardlastprofilen Gas. Berlin.

LDBV 2015: 3D-Building model (LoD2) (Data set).

STADTWERKE UNNA 2015: VDEW Lastprofile (Data set). Available at: http://www.gipsprojekt.de/featureGips/Gips;jsessionid=36DBE8EAF15E68329A3F6493121749DB?Session-Mandant=sw_unna&Anwendung=EnWGKnotenAnzeigen&PrimaryId=133029&Mandantkuerzel=sw_unna&Navigation=J (10 October 2015: 10 October 2015).

BAYLFSTAD 2011: Zensus. Bayerisches Landesamt für Statistik, Wiesbaden.

A. Appendix

Table A 1: Parametrization of the load profile factor fE for residential buildings and miscellaneous [-]. (Source: Stadtwerke Unna (2015))

Hour	Winter			Spring / Autumn			Summer		
	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00	0.08639	0.10391	0.08464	0.10027	0.11651	0.09398	0.11208	0.12466	0.10807
01	0.05831	0.06704	0.07816	0.06658	0.07315	0.08429	0.07365	0.08300	0.08961
02	0.04315	0.05287	0.05630	0.04917	0.05627	0.06220	0.05484	0.06433	0.06665
03	0.03955	0.04210	0.04507	0.04429	0.04645	0.04890	0.04978	0.05231	0.05448
04	0.03851	0.03970	0.04112	0.04311	0.04376	0.04429	0.04686	0.05004	0.05061
05	0.03913	0.03846	0.03873	0.04407	0.04315	0.04315	0.04878	0.05048	0.04998
06	0.04684	0.04008	0.03862	0.05264	0.04515	0.04326	0.05926	0.05163	0.04877
07	0.09009	0.05310	0.04096	0.09291	0.05859	0.04575	0.09790	0.06371	0.05133
08	0.12943	0.08195	0.04999	0.12972	0.09326	0.06556	0.12971	0.09311	0.06947
09	0.13350	0.11971	0.08853	0.13747	0.12970	0.11122	0.14164	0.12837	0.11247
10	0.12322	0.14173	0.13850	0.13597	0.15040	0.15954	0.14407	0.15575	0.16024
11	0.11621	0.14787	0.17417	0.13204	0.16328	0.18509	0.13924	0.16486	0.18659
12	0.11832	0.15499	0.20278	0.13328	0.17181	0.20519	0.14196	0.17113	0.20574
13	0.13071	0.16660	0.20670	0.14961	0.18139	0.20780	0.15783	0.18212	0.20944
14	0.12950	0.16580	0.17302	0.14566	0.17745	0.16865	0.15269	0.17598	0.17537
15	0.11535	0.15345	0.13612	0.12678	0.16128	0.13623	0.13177	0.15718	0.14407
16	0.10482	0.14380	0.11660	0.11344	0.14864	0.12101	0.11879	0.14836	0.12437
17	0.10521	0.14472	0.10670	0.10614	0.14653	0.10730	0.11479	0.14486	0.10838
18	0.12867	0.18049	0.12570	0.11633	0.15936	0.11175	0.12249	0.14896	0.10959
19	0.16619	0.20941	0.15641	0.14485	0.18329	0.13755	0.14217	0.16648	0.12665
20	0.18708	0.21012	0.17629	0.17189	0.19804	0.16092	0.16517	0.18039	0.15202
21	0.16824	0.17196	0.16012	0.16805	0.18038	0.15472	0.16658	0.17288	0.15941
22	0.14097	0.13409	0.13554	0.15595	0.14734	0.14392	0.15755	0.15382	0.15054
23	0.11667	0.12250	0.11476	0.13568	0.13857	0.12765	0.14451	0.14859	0.14020

Table A 2: Parametrization of the load profile factor fE for ITC buildings [-]. (Source: Stadtwerke Unna (2015))

Hour	Winter			Spring / Autumn			Summer		
	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00	0.07116	0.06858	0.06171	0.07841	0.07287	0.06497	0.07627	0.07205	0.06576
01	0.06118	0.07410	0.06004	0.06866	0.07718	0.06552	0.06758	0.07676	0.06635
02	0.05251	0.07336	0.05288	0.06001	0.07692	0.05675	0.05782	0.07506	0.05688
03	0.04834	0.06489	0.04618	0.05531	0.06967	0.04885	0.05364	0.06857	0.05119
04	0.04979	0.06386	0.04246	0.05562	0.06800	0.04473	0.05412	0.06693	0.04808
05	0.05952	0.06605	0.04187	0.06608	0.07033	0.04367	0.06500	0.06952	0.04657
06	0.06681	0.07066	0.04404	0.07505	0.07253	0.04523	0.07129	0.07246	0.04615
07	0.08053	0.08002	0.04953	0.08120	0.07482	0.04547	0.07522	0.07675	0.04698
08	0.11529	0.11816	0.05128	0.10781	0.11368	0.04989	0.10213	0.11361	0.05313
09	0.18847	0.16960	0.04922	0.17433	0.16858	0.05327	0.16359	0.16076	0.05379
10	0.22910	0.19363	0.05541	0.21132	0.18728	0.06100	0.19835	0.17601	0.05862
11	0.23242	0.20382	0.06602	0.21415	0.19101	0.06908	0.20289	0.18039	0.06640
12	0.23919	0.20742	0.07280	0.22074	0.19505	0.07681	0.20867	0.18499	0.07228
13	0.21983	0.19724	0.07780	0.20536	0.19207	0.08276	0.19642	0.18047	0.07732
14	0.18382	0.17248	0.08008	0.17491	0.16876	0.08130	0.17144	0.15816	0.07911
15	0.17277	0.12919	0.07448	0.16518	0.12591	0.07422	0.16502	0.11784	0.07302
16	0.19055	0.09564	0.06614	0.17883	0.09491	0.06684	0.17543	0.08890	0.06413
17	0.20090	0.08362	0.06239	0.18288	0.07896	0.06202	0.17599	0.07719	0.06013
18	0.20404	0.09124	0.07899	0.17950	0.07981	0.07247	0.17030	0.07536	0.06751
19	0.16817	0.09696	0.09195	0.14416	0.08413	0.08029	0.13963	0.07864	0.07540
20	0.11683	0.09689	0.09402	0.10156	0.08665	0.08413	0.09817	0.07968	0.07878
21	0.09558	0.09363	0.08923	0.09110	0.09114	0.08831	0.08894	0.08460	0.08308
22	0.08381	0.08536	0.07831	0.08613	0.08794	0.08306	0.08726	0.08536	0.08175
23	0.07609	0.07696	0.07012	0.08168	0.08030	0.07288	0.08086	0.07842	0.07433

Table A 3: Parametrization of the hourly temperature factor FT for single-family houses [1E-4] (Source: BDEW (2016))

Hour	Temperature range [°C]									
	-15	-10	-05	00	05	10	15	20	25	> 25
00	3.01	2.97	2.87	2.77	2.50	2.20	1.75	1.43	1.07	1.07
01	2.98	2.94	2.84	2.65	2.33	1.97	1.40	0.95	0.48	0.48
02	2.95	2.91	2.81	2.69	2.40	2.10	1.56	1.06	0.60	0.60
03	3.00	2.96	2.87	2.75	2.45	2.18	1.70	1.13	0.46	0.46
04	3.08	3.04	2.95	2.90	2.63	2.50	2.02	1.65	0.84	0.84
05	3.21	3.18	3.10	3.30	3.10	3.22	2.93	2.82	1.90	1.90
06	3.80	3.80	3.74	4.25	4.43	4.76	5.37	6.55	5.95	5.95
07	5.87	5.75	6.03	5.55	5.78	6.16	6.77	8.00	9.08	9.08
08	5.25	5.30	5.38	5.10	5.36	5.79	6.87	7.67	8.26	8.26
09	4.94	4.98	5.04	4.93	5.07	5.28	5.81	6.12	6.15	6.15
10	4.74	4.77	4.81	4.79	4.87	4.87	5.30	6.01	5.93	5.93
11	4.65	4.68	4.71	4.67	4.65	4.53	4.83	5.23	5.52	5.52
12	4.36	4.37	4.38	4.44	4.47	4.29	4.38	4.85	5.29	5.29
13	4.22	4.23	4.23	4.38	4.38	4.24	4.14	4.43	5.16	5.16
14	4.21	4.21	4.21	4.33	4.35	4.20	4.04	4.01	4.24	4.24
15	4.15	4.16	4.15	4.45	4.43	4.30	3.99	3.83	4.07	4.07
16	4.34	4.35	4.35	4.52	4.54	4.47	4.12	3.62	3.63	3.63
17	4.72	4.76	4.79	4.80	4.80	4.76	4.39	4.03	4.29	4.29
18	4.81	4.85	4.90	4.89	5.01	5.08	4.72	4.31	4.92	4.92
19	4.72	4.75	4.79	4.91	5.06	5.21	5.09	4.50	4.76	4.76
20	4.68	4.71	4.75	4.85	5.05	5.27	5.48	5.09	5.02	5.02
21	4.60	4.63	4.66	4.68	4.87	5.07	5.33	5.16	5.25	5.25
22	4.24	4.25	4.25	4.16	4.33	4.46	4.76	4.41	4.45	4.45
23	3.47	3.45	3.39	3.24	3.14	3.09	3.25	3.14	2.68	2.68

Table A 4: Parametrization of the hourly temperature factor FT for multifamily houses [1E-4] (Source: BDEW (2016))

Hour	Temperature range [°C]									
	-15	-15 - -10	-10 - -05	-05 - 00	00 - 05	05 - 10	10 - 15	15 - 20	20 – 25	> 25
00	3.24	3.23	3.19	2.76	2.76	2.84	2.84	2.98	3.17	3.17
01	3.01	3.00	2.94	2.57	2.32	2.22	2.14	2.16	2.39	2.39
02	2.97	2.95	2.89	2.65	2.48	2.43	2.11	2.18	2.51	2.51
03	2.94	2.92	2.86	2.70	2.53	2.34	2.06	2.03	2.41	2.41
04	3.04	3.03	2.97	2.90	2.75	2.59	2.33	2.24	2.33	2.33
05	3.51	3.51	3.48	3.46	3.37	3.46	3.41	3.64	3.70	3.70
06	5.37	5.40	5.44	5.09	5.08	5.08	5.19	5.32	4.98	4.98
07	5.64	5.32	5.33	5.10	5.09	5.23	6.01	5.96	4.45	4.45
08	4.64	4.67	4.70	4.84	4.95	5.09	5.58	5.86	5.76	5.76
09	4.59	4.62	4.64	4.91	4.87	4.97	5.26	5.25	5.05	5.05
10	4.45	4.48	4.49	4.81	4.76	4.70	4.93	5.16	5.13	5.13
11	4.20	4.22	4.23	4.65	4.63	4.53	4.68	4.81	4.83	4.83
12	4.33	4.35	4.37	4.53	4.46	4.36	4.42	4.55	4.66	4.66
13	4.24	4.26	4.27	4.47	4.42	4.27	4.31	4.52	4.69	4.69
14	4.20	4.21	4.22	4.38	4.40	4.21	4.18	4.11	4.29	4.29
15	4.18	4.19	4.20	4.36	4.42	4.22	4.03	4.07	4.37	4.37
16	4.29	4.31	4.31	4.40	4.46	4.33	4.05	3.86	4.00	4.00
17	4.36	4.38	4.40	4.58	4.65	4.55	4.14	3.91	3.93	3.93
18	4.57	4.60	4.62	4.72	4.81	4.78	4.35	4.09	4.19	4.19
19	4.53	4.56	4.58	4.78	4.91	4.99	4.68	4.43	4.41	4.41
20	4.64	4.66	4.69	4.76	4.91	5.13	5.05	4.72	4.55	4.55
21	4.55	4.58	4.61	4.61	4.80	5.10	5.18	4.98	4.97	4.97
22	4.32	4.35	4.36	4.23	4.40	4.67	4.97	4.95	4.83	4.83
23	4.19	4.20	4.21	3.74	3.77	3.91	4.10	4.22	4.40	4.40

Table A 5: Parametrization of the hourly temperature factor FT for industry buildings [1E-2] (Source: BDEW (2016))

	Hour	Temperature range [°C]									
		-15	-10	-05	00	05	10	15	20	25	> 25
Monday	00	3.48	3.46	3.39	3.10	3.02	2.95	2.80	2.85	2.67	2.67
	01	3.16	3.29	3.23	3.04	3.00	2.84	2.69	2.64	2.45	2.45
	02	3.29	3.39	3.29	3.18	3.12	3.09	3.01	3.07	3.08	3.08
	03	3.44	3.42	3.35	3.25	3.21	3.20	3.22	3.04	3.18	3.18
	04	3.73	3.70	3.60	3.45	3.49	3.51	3.56	3.37	3.25	3.25
	05	3.74	3.72	3.70	3.66	3.81	4.03	4.17	4.20	4.33	4.33
	06	4.38	4.36	4.46	4.50	4.61	4.67	5.12	5.43	7.02	7.02
	07	5.46	5.17	5.21	5.19	5.28	5.37	6.30	6.86	7.73	7.73
	08	5.28	5.31	5.31	5.46	5.44	5.69	6.49	7.20	7.73	7.73
	09	5.33	5.24	5.18	5.38	5.32	5.55	5.77	5.72	5.46	5.46
	10	4.94	4.91	4.91	5.19	5.10	5.19	5.38	5.24	5.05	5.05
	11	4.62	4.61	4.64	4.88	4.87	4.87	4.88	4.91	4.94	4.94
	12	4.52	4.50	4.55	4.63	4.59	4.47	4.48	4.44	4.61	4.61
	13	4.31	4.28	4.33	4.48	4.34	4.33	4.14	4.36	4.38	4.38
	14	4.26	4.20	4.21	4.35	4.27	4.10	3.90	3.81	3.52	3.52
	15	4.30	4.17	4.16	4.21	4.20	4.03	3.71	3.73	3.29	3.29
	16	4.34	4.23	4.21	4.15	4.22	3.99	3.74	3.40	3.23	3.23
	17	4.31	4.18	4.16	4.14	4.23	4.11	3.55	3.26	2.92	2.92
	18	4.27	4.20	4.26	4.26	4.31	4.13	3.66	3.40	3.04	3.04
	19	3.97	4.08	4.17	4.24	4.27	4.23	3.76	3.55	3.16	3.16
	20	3.82	4.02	4.12	4.17	4.18	4.21	4.07	3.89	3.72	3.72
	21	3.72	3.92	3.92	3.93	3.99	4.17	4.09	4.14	4.02	4.02
	22	3.66	3.91	3.83	3.74	3.80	3.90	4.00	3.93	3.67	3.67
	23	3.67	3.73	3.81	3.42	3.33	3.37	3.51	3.56	3.55	3.55
Tuesday	00	3.47	3.45	3.37	3.06	2.98	2.86	2.67	2.70	2.50	2.50
	01	3.24	3.34	3.25	3.04	3.00	2.84	2.69	2.45	2.33	2.33
	02	3.36	3.44	3.31	3.17	3.17	3.03	2.96	2.94	2.93	2.93
	03	3.51	3.46	3.36	3.24	3.26	3.15	3.17	2.98	3.05	3.05
	04	3.74	3.72	3.61	3.45	3.49	3.45	3.44	3.32	3.12	3.12
	05	3.78	3.72	3.68	3.61	3.81	3.97	4.12	4.16	4.28	4.28
	06	4.42	4.37	4.46	4.51	4.59	4.62	5.12	5.31	6.88	6.88
	07	5.52	5.22	5.26	5.22	5.28	5.43	6.38	6.91	7.81	7.81
	08	5.29	5.33	5.34	5.47	5.53	5.75	6.56	7.23	7.76	7.76
	09	5.38	5.30	5.29	5.55	5.41	5.81	6.04	6.02	5.84	5.84
	10	4.93	4.91	4.91	5.18	5.17	5.31	5.57	5.50	5.43	5.43
	11	4.64	4.64	4.66	4.88	4.90	4.93	5.03	5.18	5.32	5.32
	12	4.52	4.50	4.54	4.70	4.61	4.60	4.62	4.63	4.94	4.94
	13	4.27	4.26	4.33	4.49	4.40	4.38	4.25	4.59	4.68	4.68
	14	4.18	4.16	4.17	4.32	4.28	4.22	4.02	3.97	3.74	3.74
	15	4.22	4.14	4.17	4.26	4.21	4.16	3.76	3.71	3.31	3.31
	16	4.30	4.23	4.27	4.27	4.24	4.09	3.68	3.43	3.18	3.18
	17	4.26	4.16	4.17	4.20	4.28	4.08	3.59	3.22	2.75	2.75
	18	4.27	4.18	4.23	4.25	4.23	4.15	3.59	3.33	2.93	2.93
	19	3.95	4.05	4.09	4.15	4.13	4.06	3.67	3.47	3.09	3.09
	20	3.82	4.01	4.11	4.11	4.04	4.07	3.95	3.79	3.60	3.60
	21	3.73	3.92	3.95	3.93	3.99	4.04	3.90	3.95	3.75	3.75

	22	3.60	3.85	3.77	3.64	3.73	3.79	3.85	3.78	3.44	3.44
	23	3.60	3.64	3.70	3.30	3.27	3.21	3.37	3.43	3.34	3.34
Wednesday	00	3.47	3.45	3.37	3.06	2.98	2.86	2.67	2.70	2.50	2.50
	01	3.24	3.34	3.25	3.04	3.00	2.84	2.69	2.45	2.33	2.33
	02	3.36	3.44	3.31	3.17	3.17	3.03	2.96	2.94	2.93	2.93
	03	3.51	3.46	3.36	3.24	3.26	3.15	3.17	2.98	3.05	3.05
	04	3.74	3.72	3.61	3.45	3.49	3.45	3.44	3.32	3.12	3.12
	05	3.78	3.72	3.68	3.61	3.81	3.97	4.12	4.16	4.28	4.28
	06	4.42	4.37	4.46	4.51	4.59	4.62	5.12	5.31	6.88	6.88
	07	5.52	5.22	5.26	5.22	5.28	5.43	6.38	6.91	7.81	7.81
	08	5.29	5.33	5.34	5.47	5.53	5.75	6.56	7.23	7.76	7.76
	09	5.38	5.30	5.29	5.55	5.41	5.81	6.04	6.02	5.84	5.84
	10	4.93	4.91	4.91	5.18	5.17	5.31	5.57	5.50	5.43	5.43
	11	4.64	4.64	4.66	4.88	4.90	4.93	5.03	5.18	5.32	5.32
	12	4.52	4.50	4.54	4.70	4.61	4.60	4.62	4.63	4.94	4.94
	13	4.27	4.26	4.33	4.49	4.40	4.38	4.25	4.59	4.68	4.68
	14	4.18	4.16	4.17	4.32	4.28	4.22	4.02	3.97	3.74	3.74
	15	4.22	4.14	4.17	4.26	4.21	4.16	3.76	3.71	3.31	3.31
	16	4.30	4.23	4.27	4.27	4.24	4.09	3.68	3.43	3.18	3.18
	17	4.26	4.16	4.17	4.20	4.28	4.08	3.59	3.22	2.75	2.75
	18	4.27	4.18	4.23	4.25	4.23	4.15	3.59	3.33	2.93	2.93
	19	3.95	4.05	4.09	4.15	4.13	4.06	3.67	3.47	3.09	3.09
	20	3.82	4.01	4.11	4.11	4.04	4.07	3.95	3.79	3.60	3.60
	21	3.73	3.92	3.95	3.93	3.99	4.04	3.90	3.95	3.75	3.75
	22	3.60	3.85	3.77	3.64	3.73	3.79	3.85	3.78	3.44	3.44
	23	3.60	3.64	3.70	3.30	3.27	3.21	3.37	3.43	3.34	3.34
Thursday	00	3.47	3.45	3.37	3.06	2.98	2.86	2.67	2.70	2.50	2.50
	01	3.24	3.34	3.25	3.04	3.00	2.84	2.69	2.45	2.33	2.33
	02	3.36	3.44	3.31	3.17	3.17	3.03	2.96	2.94	2.93	2.93
	03	3.51	3.46	3.36	3.24	3.26	3.15	3.17	2.98	3.05	3.05
	04	3.74	3.72	3.61	3.45	3.49	3.45	3.44	3.32	3.12	3.12
	05	3.78	3.72	3.68	3.61	3.81	3.97	4.12	4.16	4.28	4.28
	06	4.42	4.37	4.46	4.51	4.59	4.62	5.12	5.31	6.88	6.88
	07	5.52	5.22	5.26	5.22	5.28	5.43	6.38	6.91	7.81	7.81
	08	5.29	5.33	5.34	5.47	5.53	5.75	6.56	7.23	7.76	7.76
	09	5.38	5.30	5.29	5.55	5.41	5.81	6.04	6.02	5.84	5.84
	10	4.93	4.91	4.91	5.18	5.17	5.31	5.57	5.50	5.43	5.43
	11	4.64	4.64	4.66	4.88	4.90	4.93	5.03	5.18	5.32	5.32
	12	4.52	4.50	4.54	4.70	4.61	4.60	4.62	4.63	4.94	4.94
	13	4.27	4.26	4.33	4.49	4.40	4.38	4.25	4.59	4.68	4.68
	14	4.18	4.16	4.17	4.32	4.28	4.22	4.02	3.97	3.74	3.74
	15	4.22	4.14	4.17	4.26	4.21	4.16	3.76	3.71	3.31	3.31
	16	4.30	4.23	4.27	4.27	4.24	4.09	3.68	3.43	3.18	3.18
	17	4.26	4.16	4.17	4.20	4.28	4.08	3.59	3.22	2.75	2.75
	18	4.27	4.18	4.23	4.25	4.23	4.15	3.59	3.33	2.93	2.93
	19	3.95	4.05	4.09	4.15	4.13	4.06	3.67	3.47	3.09	3.09
	20	3.82	4.01	4.11	4.11	4.04	4.07	3.95	3.79	3.60	3.60
	21	3.73	3.92	3.95	3.93	3.99	4.04	3.90	3.95	3.75	3.75
	22	3.60	3.85	3.77	3.64	3.73	3.79	3.85	3.78	3.44	3.44
	23	3.60	3.64	3.70	3.30	3.27	3.21	3.37	3.43	3.34	3.34
	00	3.46	3.44	3.39	3.08	2.97	2.91	2.70	2.68	2.53	2.53

Friday	01	3.33	3.38	3.35	3.02	2.96	2.80	2.73	2.53	2.60	2.60
	02	3.35	3.34	3.33	3.08	3.12	2.97	3.04	2.94	3.00	3.00
	03	3.46	3.39	3.37	3.18	3.23	3.07	3.08	2.93	3.08	3.08
	04	3.58	3.57	3.52	3.34	3.37	3.30	3.31	3.22	3.06	3.06
	05	3.54	3.52	3.52	3.49	3.67	3.76	3.89	4.00	3.98	3.98
	06	4.19	4.23	4.30	4.35	4.45	4.37	4.76	5.15	6.48	6.48
	07	5.62	5.29	5.25	5.26	5.35	5.44	6.23	6.48	7.19	7.19
	08	5.37	5.37	5.33	5.48	5.62	5.82	6.54	7.30	7.66	7.66
	09	5.22	5.25	5.27	5.57	5.47	5.89	6.12	6.25	6.04	6.04
	10	4.92	4.94	4.97	5.23	5.21	5.40	5.62	5.65	5.59	5.59
	11	4.61	4.64	4.67	4.94	4.96	5.02	5.07	5.21	5.21	5.21
	12	4.46	4.48	4.54	4.75	4.67	4.68	4.58	4.54	4.78	4.78
	13	4.26	4.24	4.28	4.54	4.42	4.43	4.46	4.49	4.56	4.56
	14	4.20	4.18	4.17	4.35	4.28	4.25	4.09	4.05	3.91	3.91
	15	4.37	4.26	4.25	4.31	4.20	4.19	3.79	3.59	3.22	3.22
	16	4.32	4.25	4.26	4.30	4.22	4.11	3.67	3.43	3.10	3.10
	17	4.24	4.18	4.17	4.24	4.26	4.06	3.59	3.13	2.63	2.63
	18	4.21	4.16	4.17	4.23	4.22	4.11	3.63	3.33	3.03	3.03
	19	4.10	4.15	4.19	4.22	4.16	4.13	3.71	3.62	3.25	3.25
	20	3.95	4.13	4.16	4.13	4.10	4.12	4.07	4.02	3.97	3.97
	21	3.85	3.98	3.98	3.93	4.00	4.06	3.95	4.03	3.95	3.95
	22	3.69	3.88	3.87	3.65	3.77	3.84	3.94	3.96	3.78	3.78
	23	3.70	3.75	3.69	3.33	3.32	3.27	3.43	3.47	3.40	3.40
Saturday	00	3.49	3.51	3.53	3.21	3.16	3.05	3.00	2.80	2.40	2.40
	01	3.30	3.36	3.39	3.21	3.20	3.01	3.25	2.92	3.45	3.45
	02	3.34	3.38	3.40	3.26	3.12	3.06	3.08	2.97	3.43	3.43
	03	3.28	3.32	3.34	3.26	3.27	3.06	3.17	2.85	2.62	2.62
	04	3.45	3.49	3.52	3.42	3.48	3.46	3.39	3.23	3.29	3.29
	05	3.41	3.52	3.53	3.66	3.80	4.02	4.10	4.01	4.05	4.05
	06	4.32	4.44	4.52	4.57	4.62	4.76	4.75	4.67	4.87	4.87
	07	5.81	5.48	5.52	5.37	5.57	5.69	5.93	6.46	7.34	7.34
	08	5.02	5.12	5.23	5.50	5.53	5.87	6.38	6.88	7.81	7.81
	09	4.87	4.97	5.07	5.21	5.37	5.72	6.03	6.13	5.83	5.83
	10	4.93	4.81	4.84	5.02	5.03	5.28	5.42	5.50	5.05	5.05
	11	4.68	4.58	4.52	4.81	4.82	4.89	5.17	5.45	5.84	5.84
	12	4.58	4.56	4.51	4.68	4.67	4.68	4.67	4.61	4.25	4.25
	13	4.36	4.35	4.31	4.47	4.30	4.41	4.41	4.48	4.16	4.16
	14	4.27	4.22	4.15	4.29	4.04	3.81	3.75	3.87	3.37	3.37
	15	4.28	4.22	4.12	4.23	3.97	3.73	3.83	4.09	4.76	4.76
	16	4.25	4.23	4.15	4.07	4.00	3.80	3.68	3.83	4.31	4.31
	17	4.10	4.10	4.07	4.13	4.13	3.90	3.50	3.67	3.72	3.72
	18	4.07	4.11	4.14	4.16	4.23	4.02	3.51	3.50	2.91	2.91
	19	4.05	4.08	4.08	4.12	4.21	4.17	3.78	3.48	3.14	3.14
	20	4.08	4.10	4.10	4.06	4.08	4.01	3.91	3.71	3.30	3.30
	21	4.10	4.10	4.05	3.98	3.96	4.08	3.78	3.62	3.23	3.23
	22	4.00	4.01	4.00	3.81	3.95	3.92	3.98	3.83	3.61	3.61
	23	3.96	3.94	3.91	3.50	3.49	3.60	3.53	3.44	3.26	3.26
Sunday	00	3.91	3.88	3.83	3.34	3.49	3.36	3.11	3.15	3.06	3.06
	01	3.60	3.64	3.65	3.33	3.29	3.21	2.90	2.85	2.94	2.94
	02	3.60	3.64	3.66	3.48	3.40	3.78	3.32	3.35	3.76	3.76
	03	3.78	3.74	3.68	3.47	3.35	3.45	3.51	3.90	4.23	4.23
	04	3.80	3.82	3.83	3.77	3.81	3.99	4.40	4.67	5.86	5.86

Sunday	05	3.67	3.80	3.92	4.11	4.62	4.83	5.83	6.08	7.20	7.20
	06	4.23	4.56	4.92	5.22	5.49	5.91	6.85	7.22	7.71	7.71
	07	5.09	4.78	4.80	4.88	4.87	5.02	5.15	5.52	5.54	5.54
	08	4.62	4.68	4.74	4.92	4.81	4.97	5.79	6.17	6.73	6.73
	09	4.32	4.39	4.48	4.82	4.74	4.65	5.01	4.69	4.60	4.60
	10	4.31	4.31	4.30	4.57	4.51	4.50	4.41	4.34	3.99	3.99
	11	4.22	4.18	4.12	4.40	4.30	4.20	4.26	4.26	4.17	4.17
	12	4.48	4.40	4.30	4.42	4.24	4.10	4.04	3.79	3.59	3.59
	13	4.31	4.20	4.06	4.18	4.02	3.88	3.84	3.72	3.63	3.63
	14	4.28	4.17	4.02	4.11	3.91	3.69	3.56	3.54	3.21	3.21
	15	4.16	4.10	4.01	4.03	4.01	3.82	3.61	3.40	2.96	2.96
	16	4.11	4.13	4.12	4.13	4.10	3.67	3.52	3.25	2.92	2.92
	17	4.13	4.14	4.13	4.16	4.04	3.94	3.56	3.20	2.73	2.73
	18	4.23	4.25	4.26	4.32	4.31	4.15	3.58	3.48	2.83	2.83
	19	4.24	4.26	4.26	4.25	4.36	4.18	3.81	3.58	3.25	3.25
	20	4.36	4.33	4.29	4.20	4.27	4.19	4.06	3.65	3.66	3.66
	21	4.22	4.25	4.27	4.14	4.27	4.38	4.08	4.08	3.65	3.65
	22	4.36	4.36	4.35	4.07	4.15	4.19	4.11	4.40	4.16	4.16
	23	3.97	3.99	4.00	3.68	3.64	3.94	3.69	3.71	3.62	3.62