TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

Validation and Analysis of Energy Performance Using Dynamic Simulations and Comparison with Detailed Measurements

Azra Korjenic, Ph.D.
Tanja Höfer M.Sc.
Christoph Deseyve M.Sc.
Thomas Bednar, Associate Professor

Research Center of Building Physics and Sound Protection
Institute of Building Construction and Technology

NSB 2011 9th Nordic Symposium on Building Physics; 29.5. – 2.6.2011 Tampere

Transformation of Building Stock

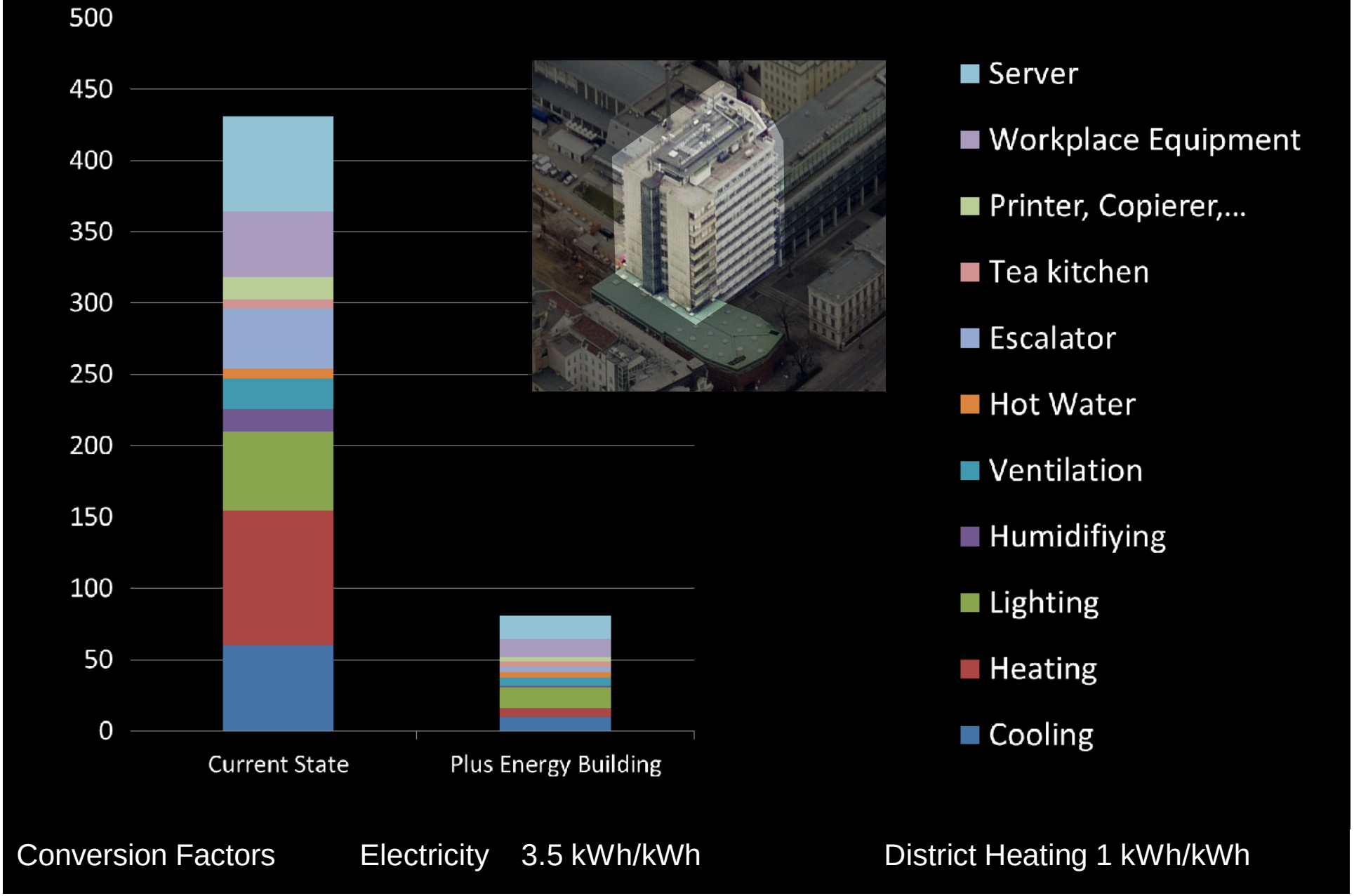
into places with comfortable and healthy indoor climate

lowest energy demand

high amount of local energy production

is the challenge.

Primary Energy kWh/m²GFA



Conversion Factors Electricity 3.5 kWh/kWh District Heating 1 kWh/kWh

Calculation models…..Accuracy?

User behaviour…..Predictability?

We need well documented
well measured

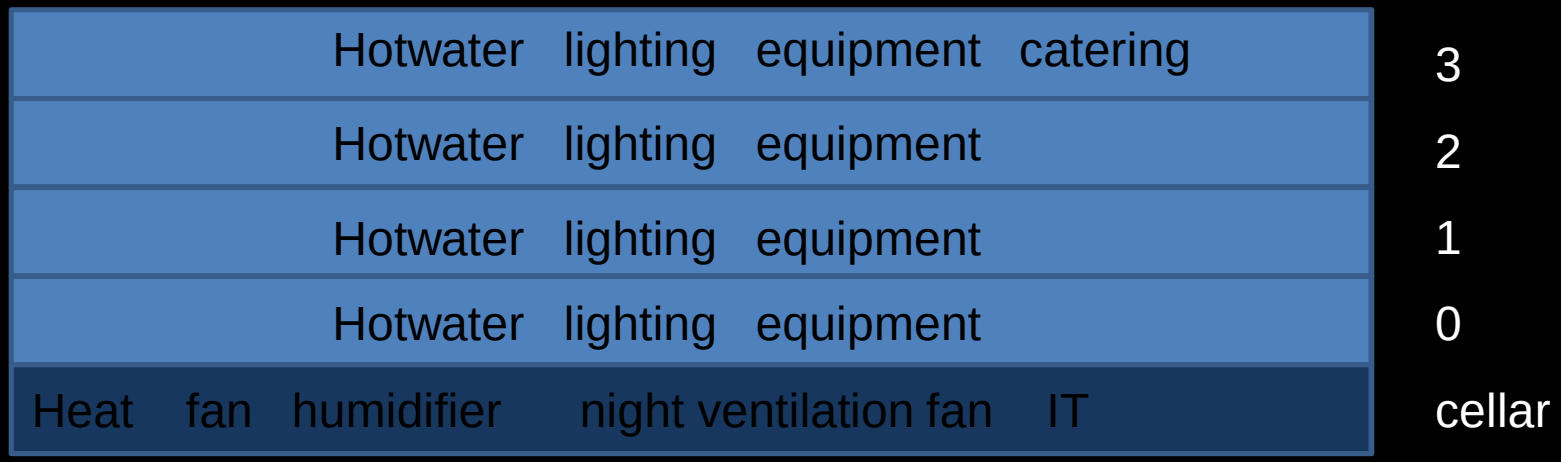
„reference“ building

Office Building in Lower Austria

- Description of the investigated building
- Calculation model
- Data Collection on Equipment/Occupancy
- Measurements - Calculations

- Gross heated floor area: 4811 m²
- Heated gross volume: 18099 m³
- Number of employees: 129 people 37m²GFA/cap

- Detailed metering of energy flows



Building Envelope

- external walls 0.2 – 0.3 W/ m² K
- flat roof 0.12 W/ m² K

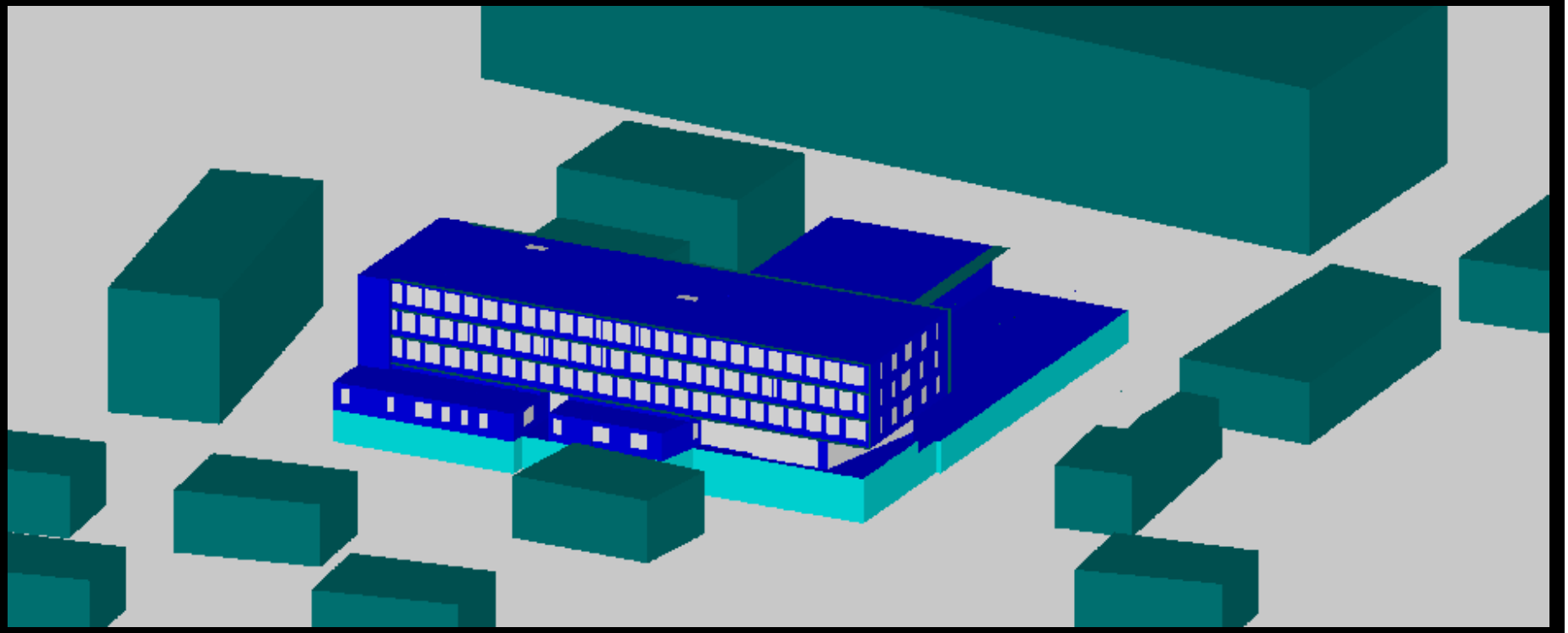
- windows:

	Frame	Glass	SHGC
	U_f W/m²K	U_g W/m²K	g -
Offices	1.4	1.1	0.5
Public Help Desks	2.2	1.1	0.37

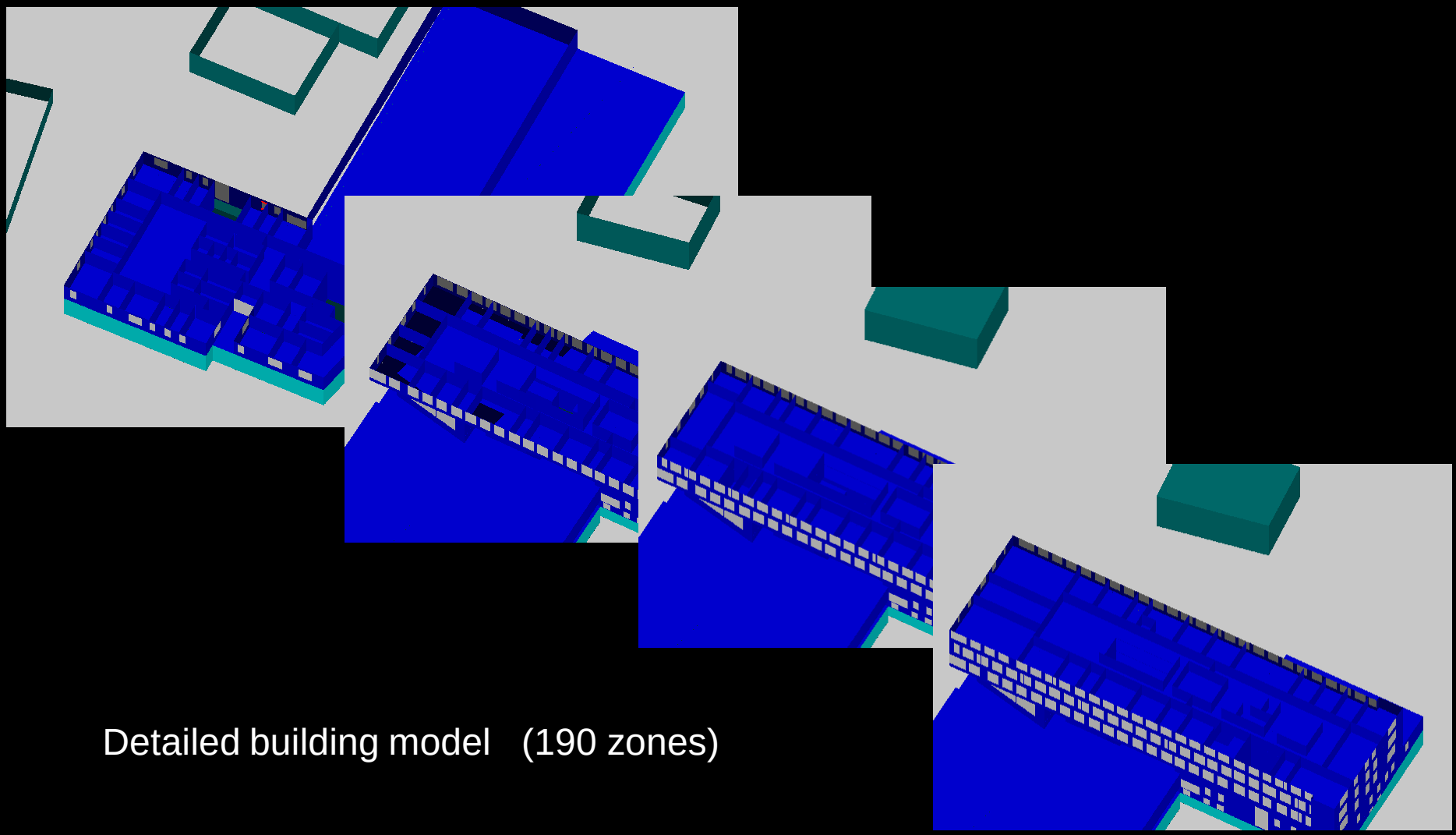
Heating and Ventilation System

- district heating
- decentralized small storage water heaters (electricicity)
- Humidifier
- ventilation system for all rooms
- night ventilation (40.000 m^3/h 12pm till 7am - summer)

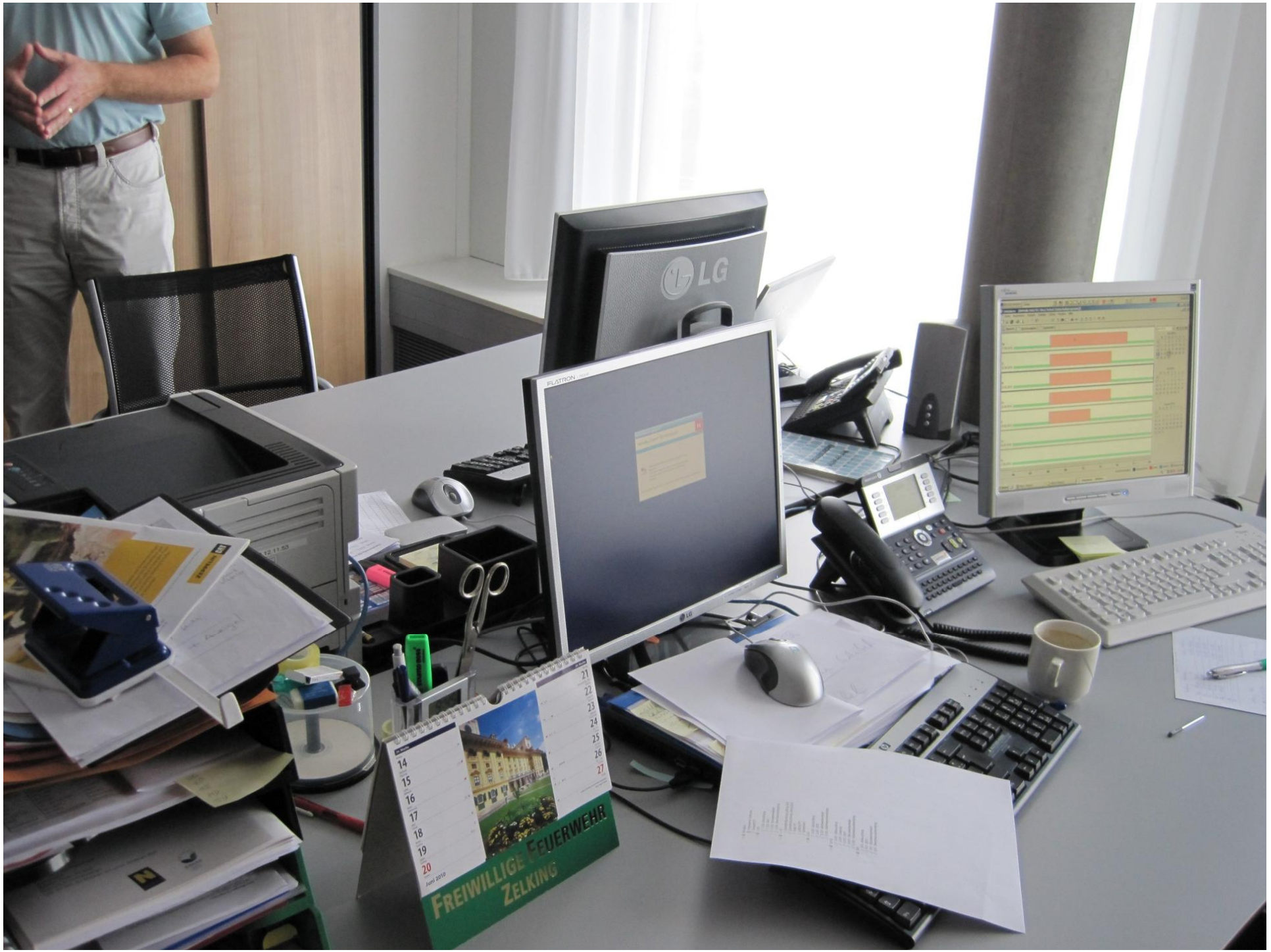
pre heating



Detailed building model



Detailed building model (190 zones)


LG
FREIWILLIGE FEUERWEHR
ZELKING

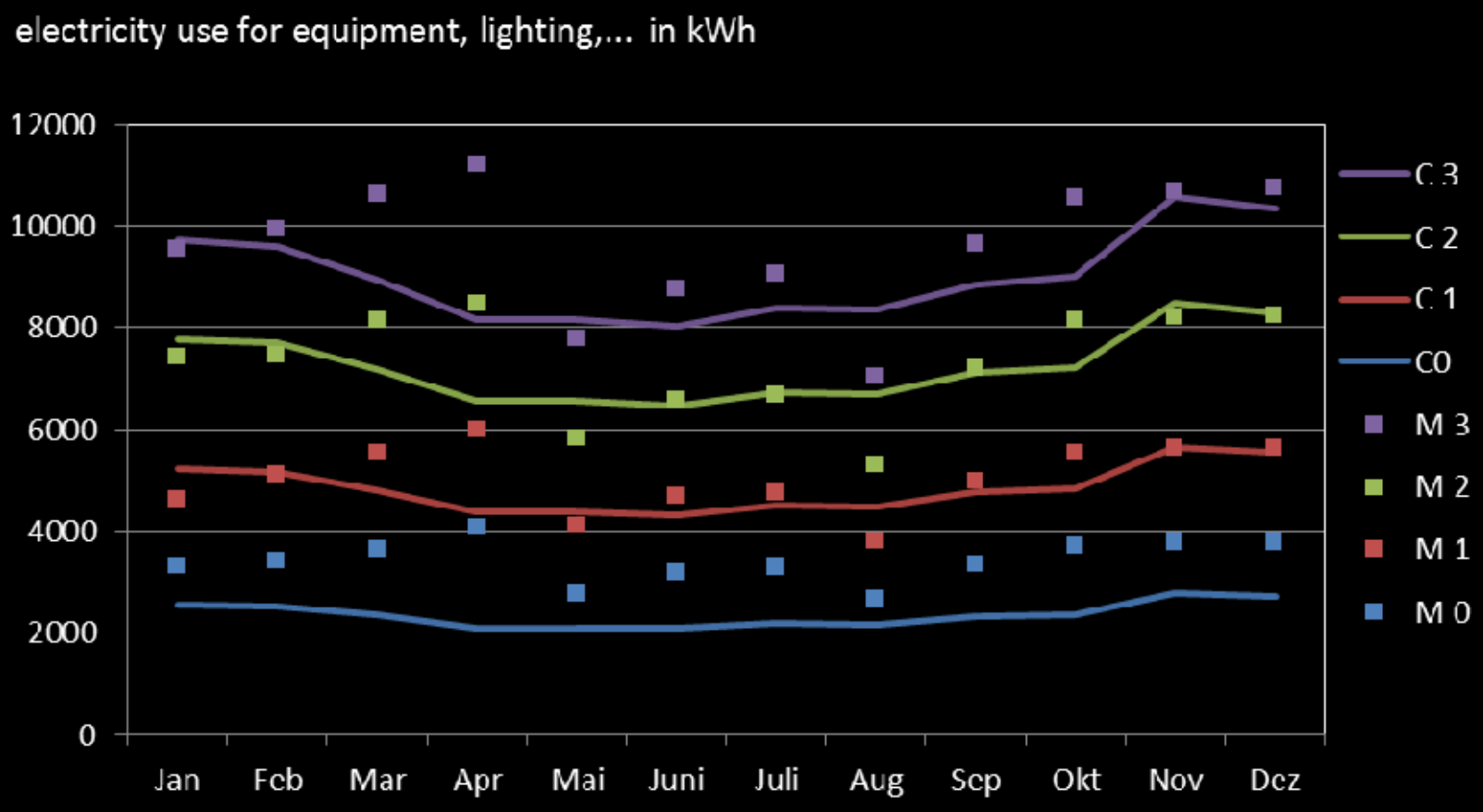
		Power in W	Power in W
	1x per	**Work time**	**Standby**
Color laser printer	office	103.0	15.4
Battery chargers	office	0.8	0.2
Radio	office	9.0	0.0
Ligthing controller	office	1.5	1.5
Fire alarm sensor	work station	0.5	0.5
Blinds controller	work station	1.5	1.5
Phone	work station	3	3
Computer	work station	Presence 56 / 53.7	2.3
Monitor	work station	Presence 18.5 / 18.1	0.35

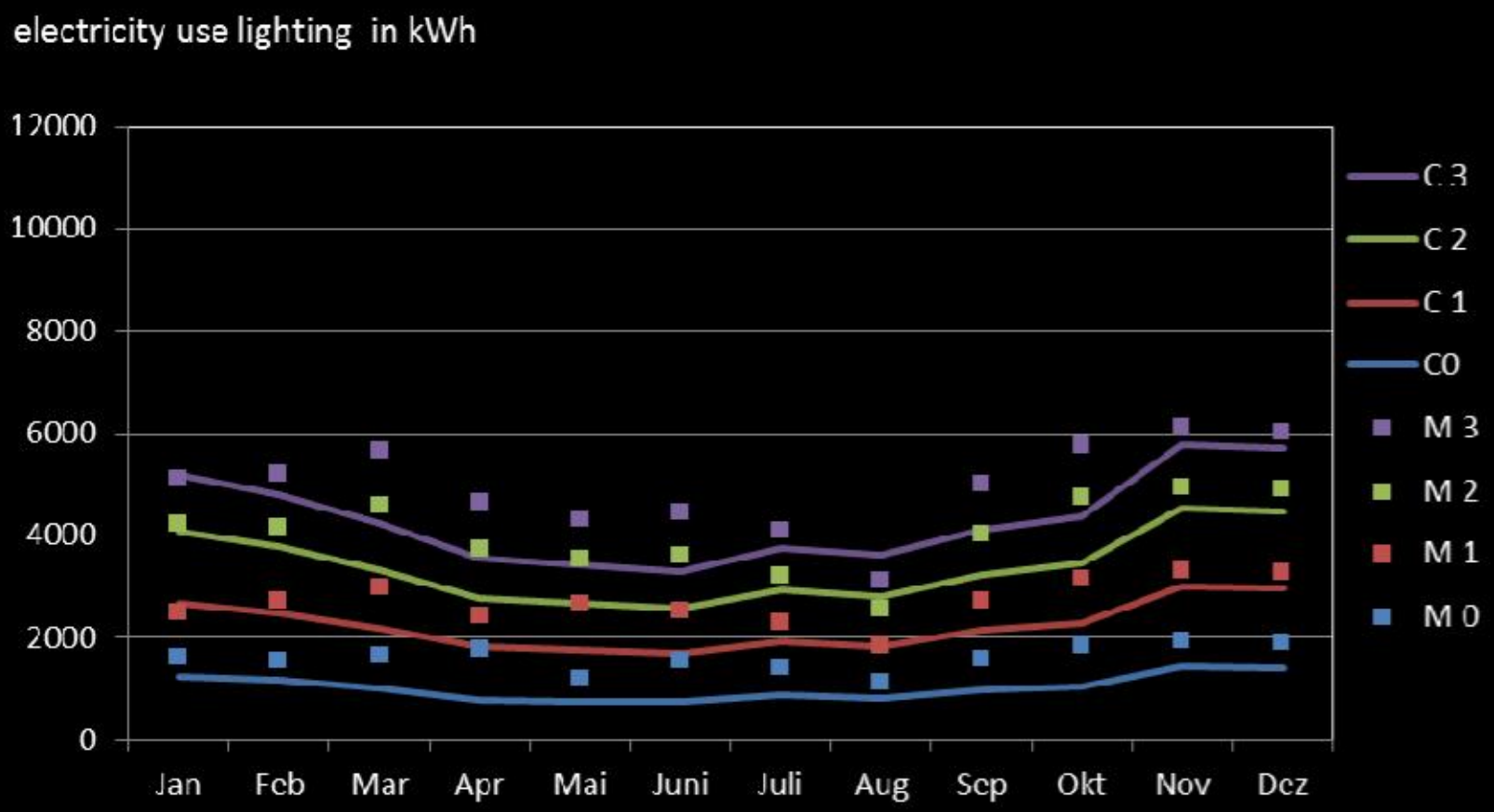
	Power in W Using time	Power in W Standby
Fire alarm sensor	0.5	0.5
Lighting controller	1.5	1.5
Blinds controller	1.5	1.5
Night ventilation	1.5	1.5
Emergency light	8	8

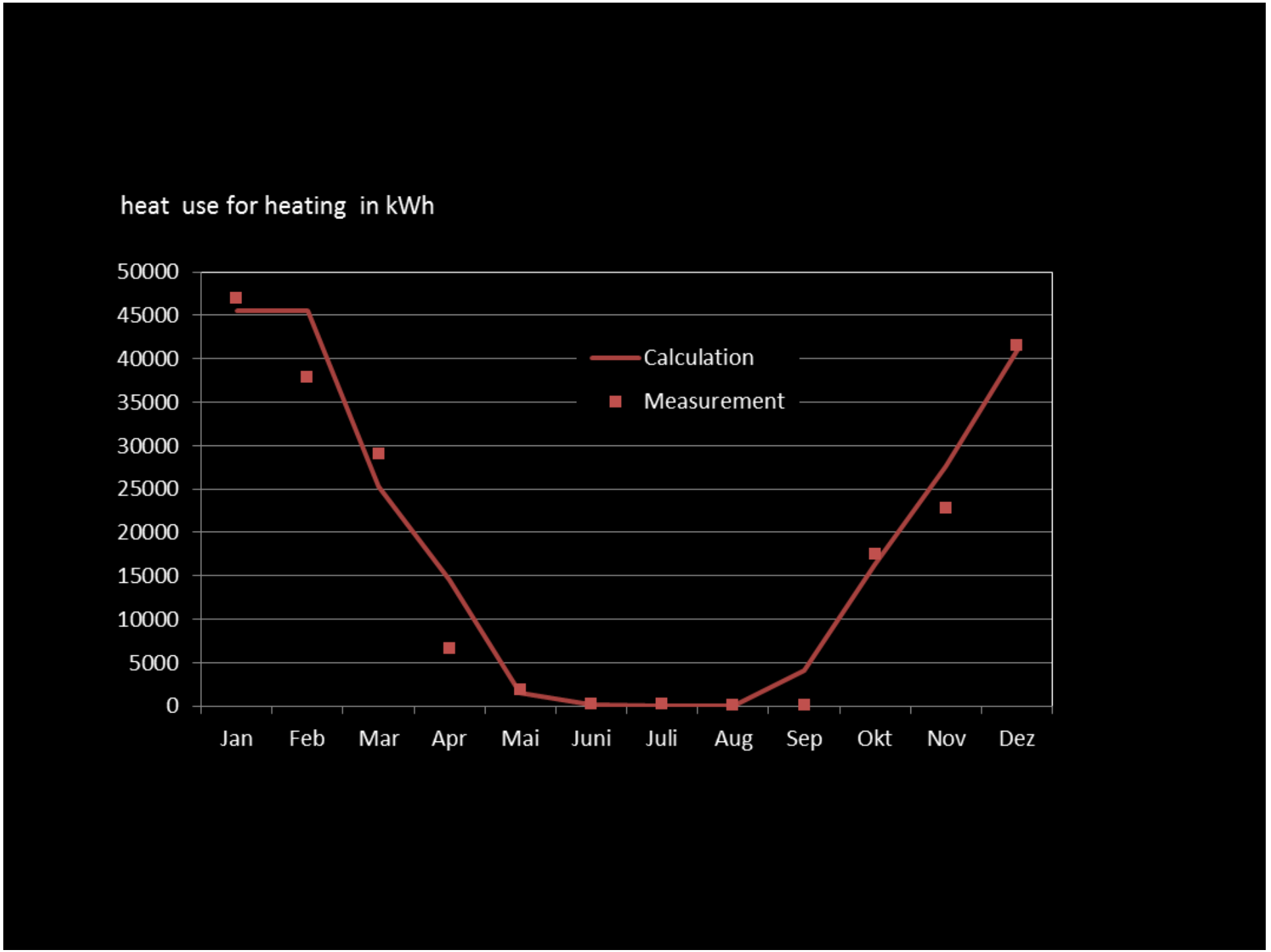
Lighting:

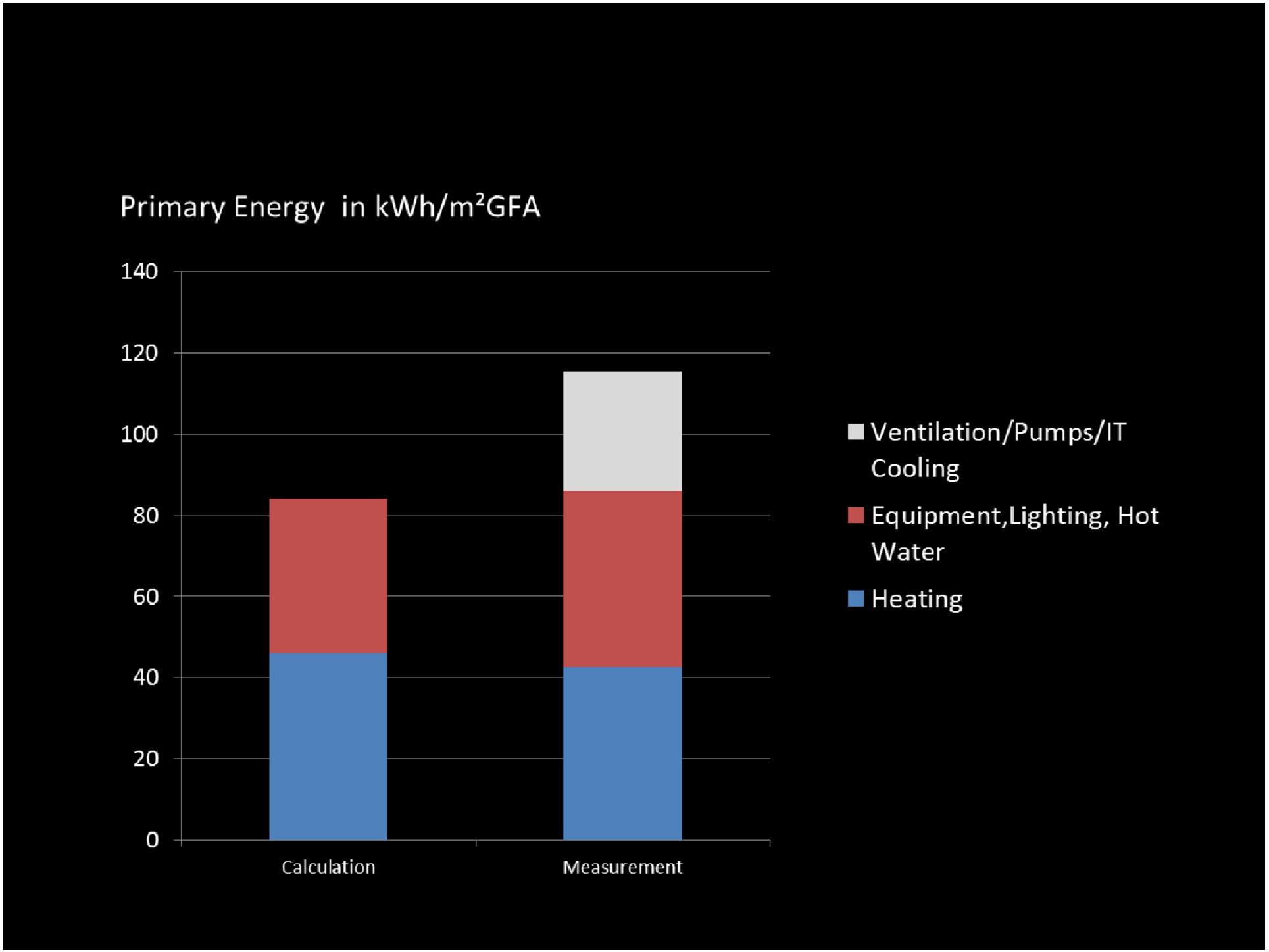
Lighting has been simulated taking into account the presence of people and the natural lighting of the rooms.

All corridor lighting has been included for the whole occupancy period.


electricity use for equipment, lighting,... in kWh
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
Mai
Juni
Juli
Aug
Sep
Okt
Nov
Dez
C 3
C 2
C 1
C0
M 3
M 2
M 1
M 0


electricity use lighting in kWh
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
Mai
Juni
Juli
Aug
Sep
Okt
Nov
Dez
C 3
C 2
C 1
C0
M 3
M 2
M 1
M 0


heat use for heating in kWh
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Calculation
Measurement
Jan
Feb
Mar
Apr
Mai
Juni
Juli
Aug
Sep
Okt
Nov
Dez


Primary Energy in kWh/m²GFA
140
120
100
80
60
40
20
0
Calculation
Measurement
Ventilation/Pumps/IT Cooling
Equipment,Lighting, Hot Water
Heating

Conclusions

- Using
  Drawings, Construction Description
  Occupancy (Schedules) / Equipment

  total energy use fits well with calculations

- Pumps/Fan electricity demand was not investigated

- Do we need detailed dynamic simulation?

Vienna University of Technology