Electric and thermal demand in "Zero Village Bergen"

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"Zero Village Bergen" in Ådland

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Content

- Building areas
- Electric demand
- Thermal demand
- Summary

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Areas summary

Building type	BRA [m2]	BRA [%]
Row houses	62 136	68 %
Apartments	23 028	25 %
Total residential	*85 164*	
Kindergarten	1 061	1 %
Shop	2 833	3 %
(with food storage)	(1500)	
Office	2 833	3 %
Total ZVB	*91 891*	*100 %*

Content

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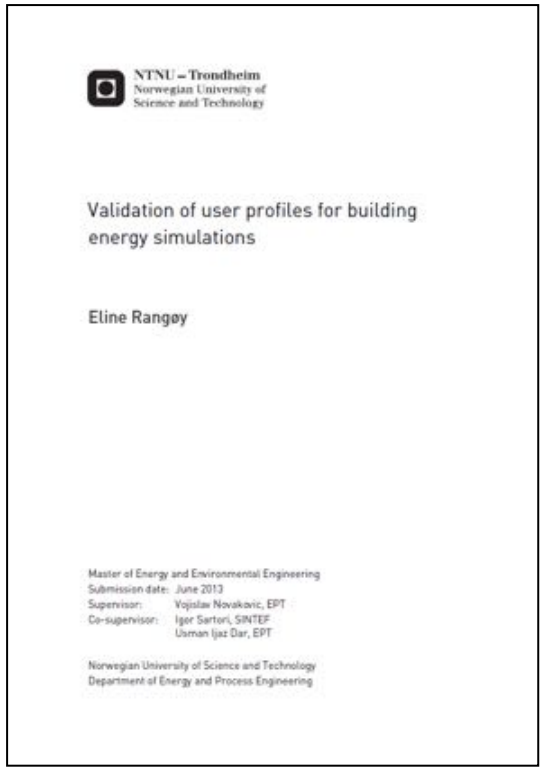
Electric demand – Method

- Ventilation fans
  - Constant, CAV ventilation (Constant Air Volume)
- Lightning and plug loads
  - Stochastic profiles
    - Modelling method based on "Time of Use Survey" from SSB
    - Statistically representative validated vs. measurements from:
      - REMODECE (EU/Norwegian project)
      - Eldek (Norwegian project)
      - Data from NVE
      - SEA (Swedish Energy Agency), only for lighting
    - Calculated with 1 min resolution
    - Hourly averages used for input to thermal model
    - **N.B.**: no induction cooker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Validation of user profiles for building energy simulations

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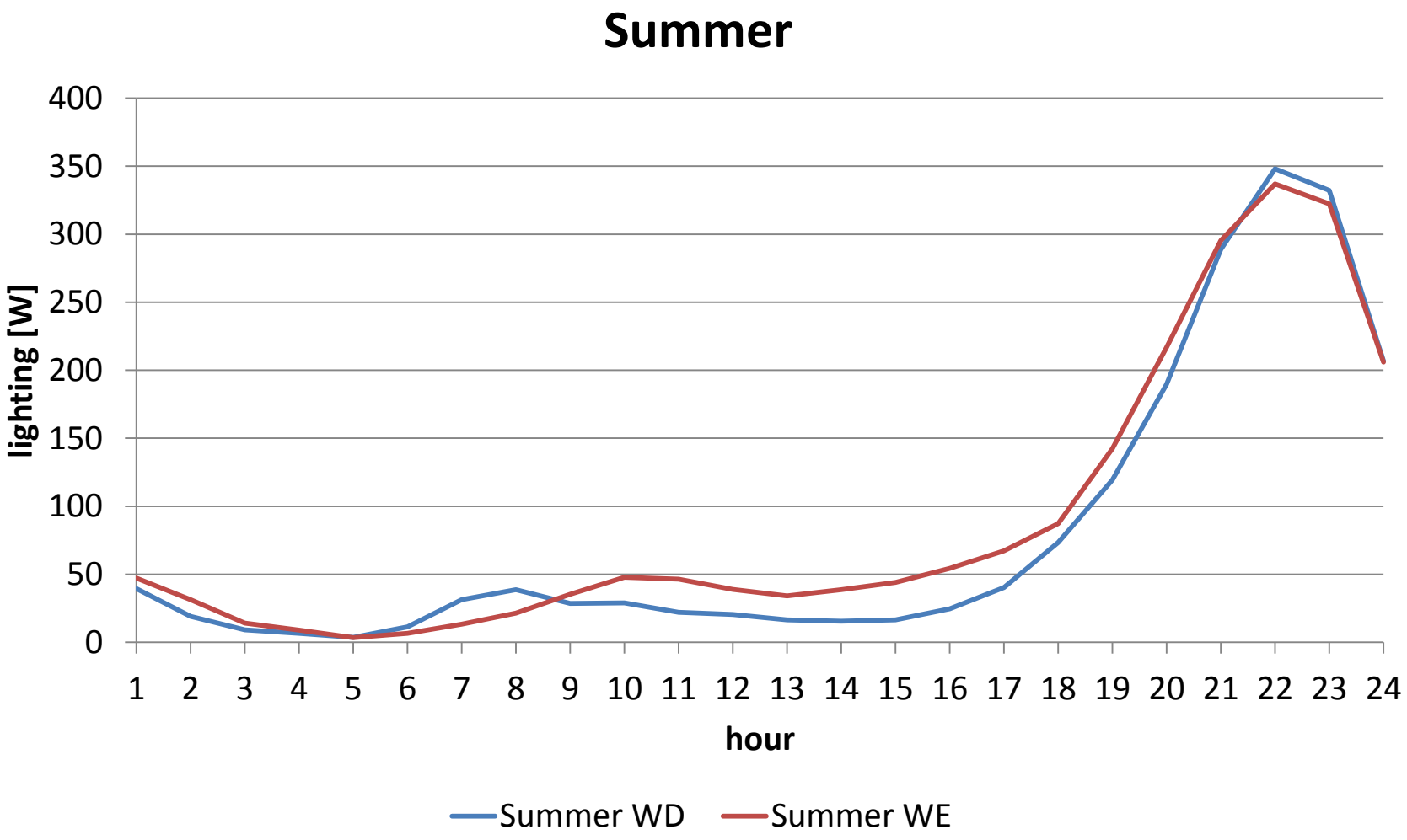
Lightning – Typical days (per dwelling)



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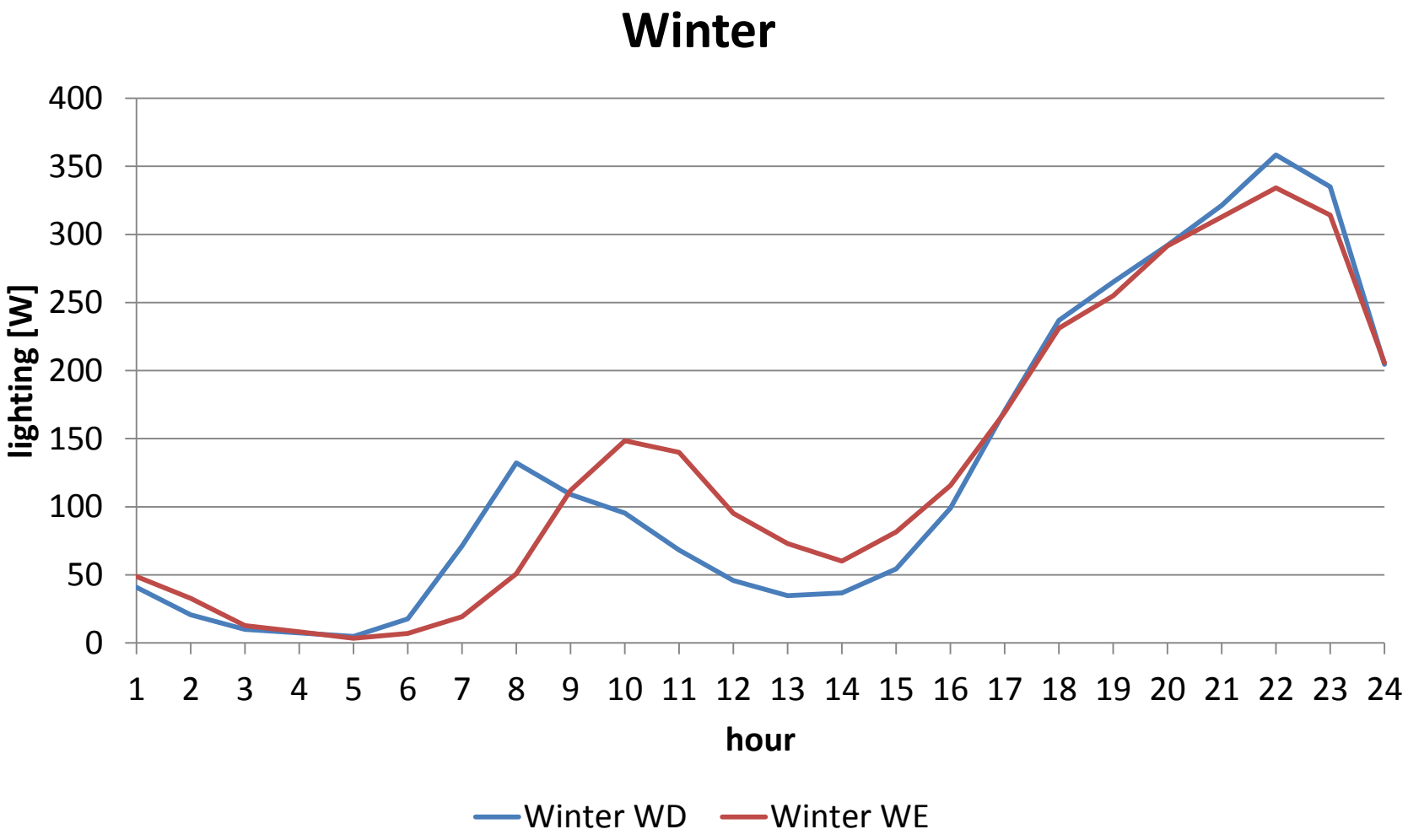

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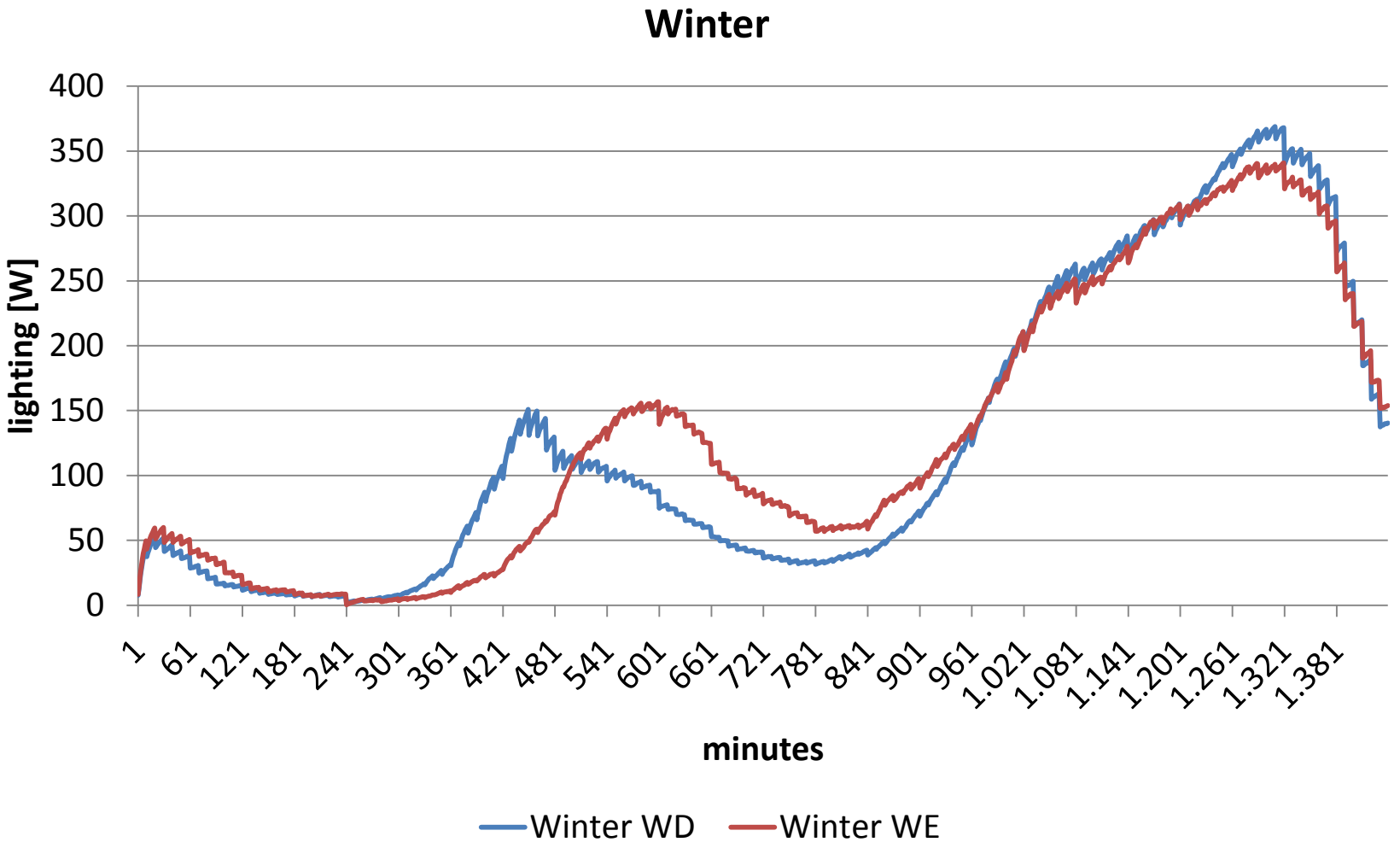
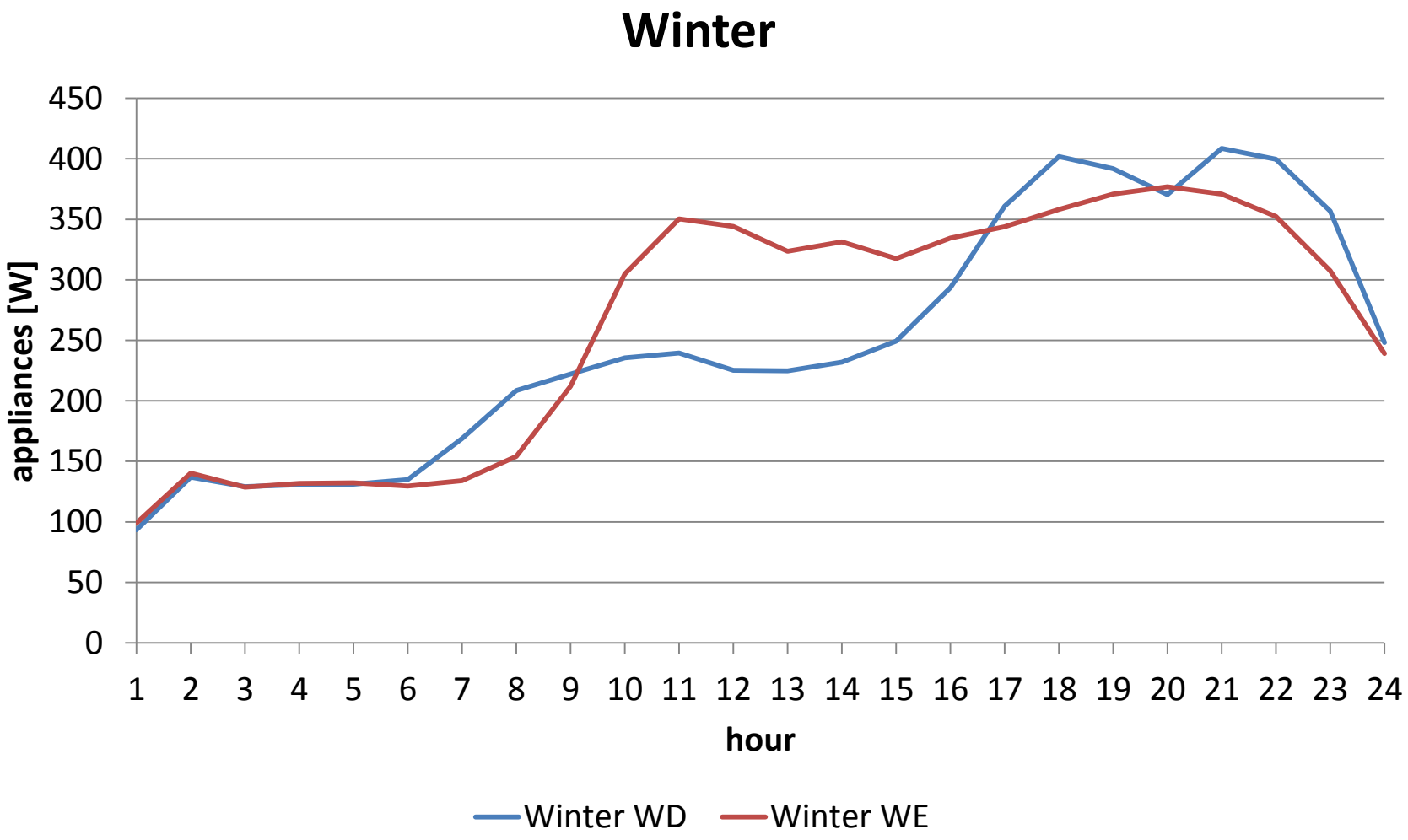


Plug loads – Typical days (per dwelling)



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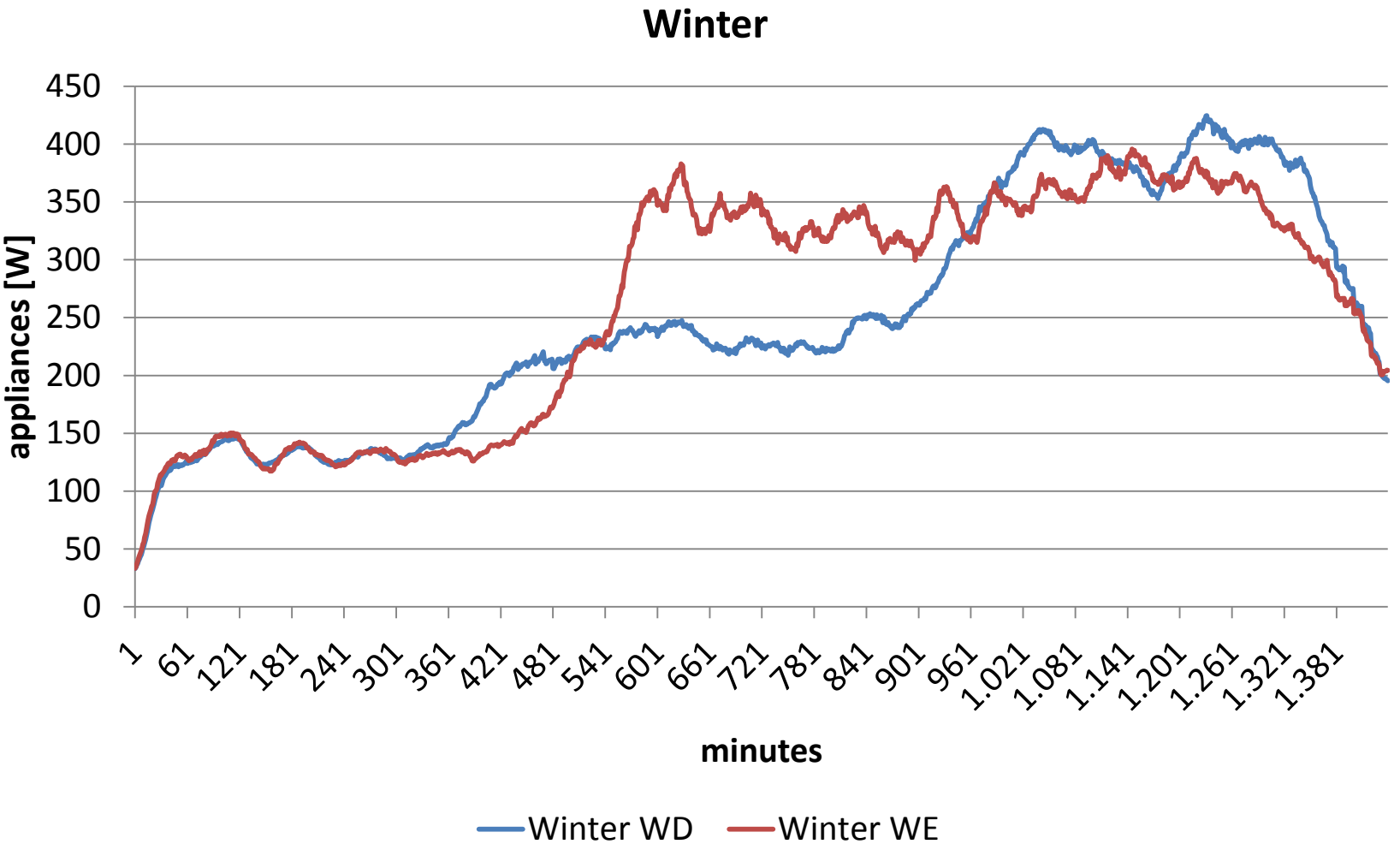


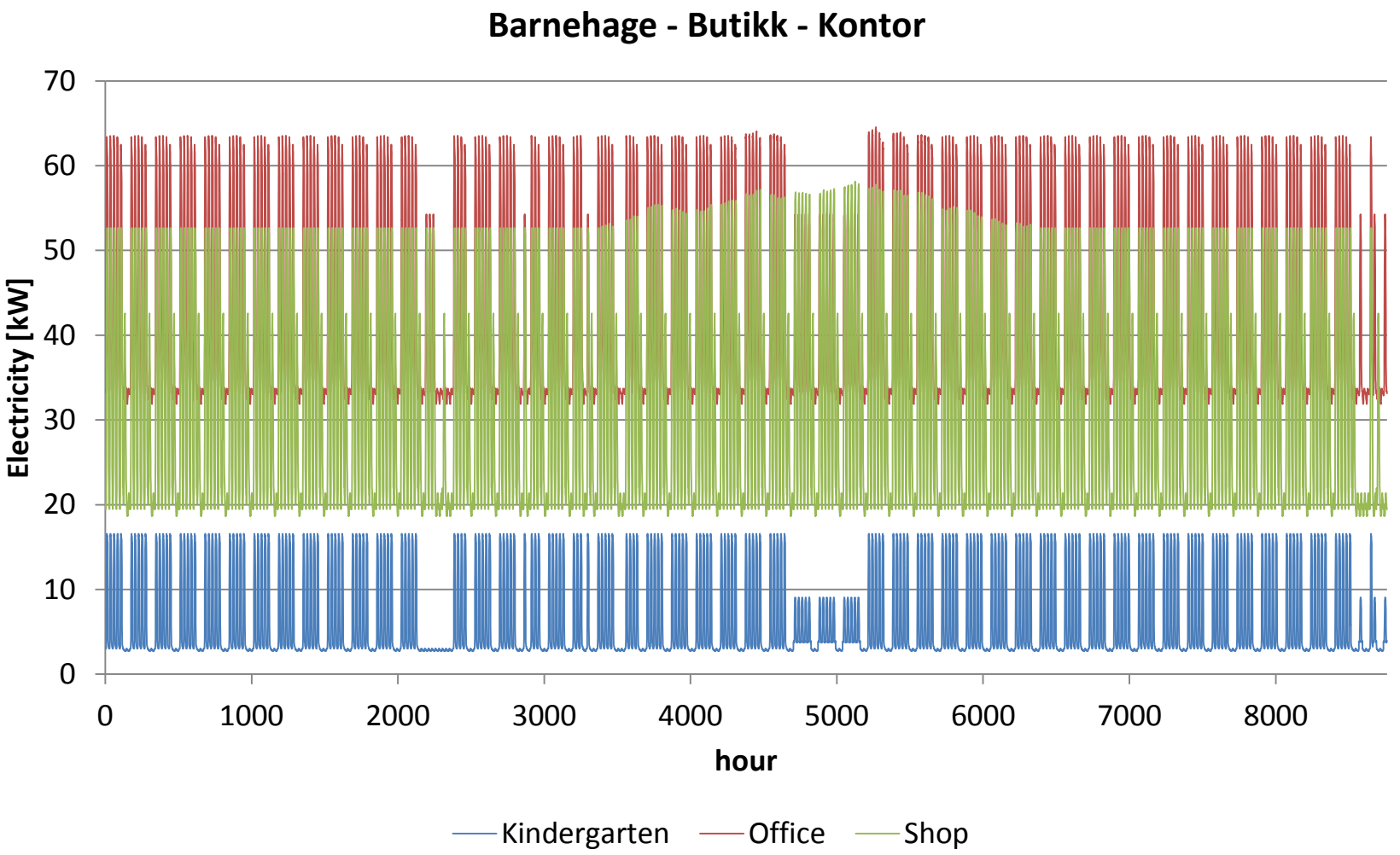
Internal gains – Comparison

	Stochastic profile		NS3031/NS3700		Simien		NVE*
Int. gain	W/m²**	kWh/m²y	W/m²	kWh/m²y	W/m²	kWh/m²y	kWh/m²y
Lightning	1.33	7.7	1.95	11.4	1.5	8.8	8.4
Plug loads	3.20	18.7	3.00	17.5	2.5	14.6	29.4

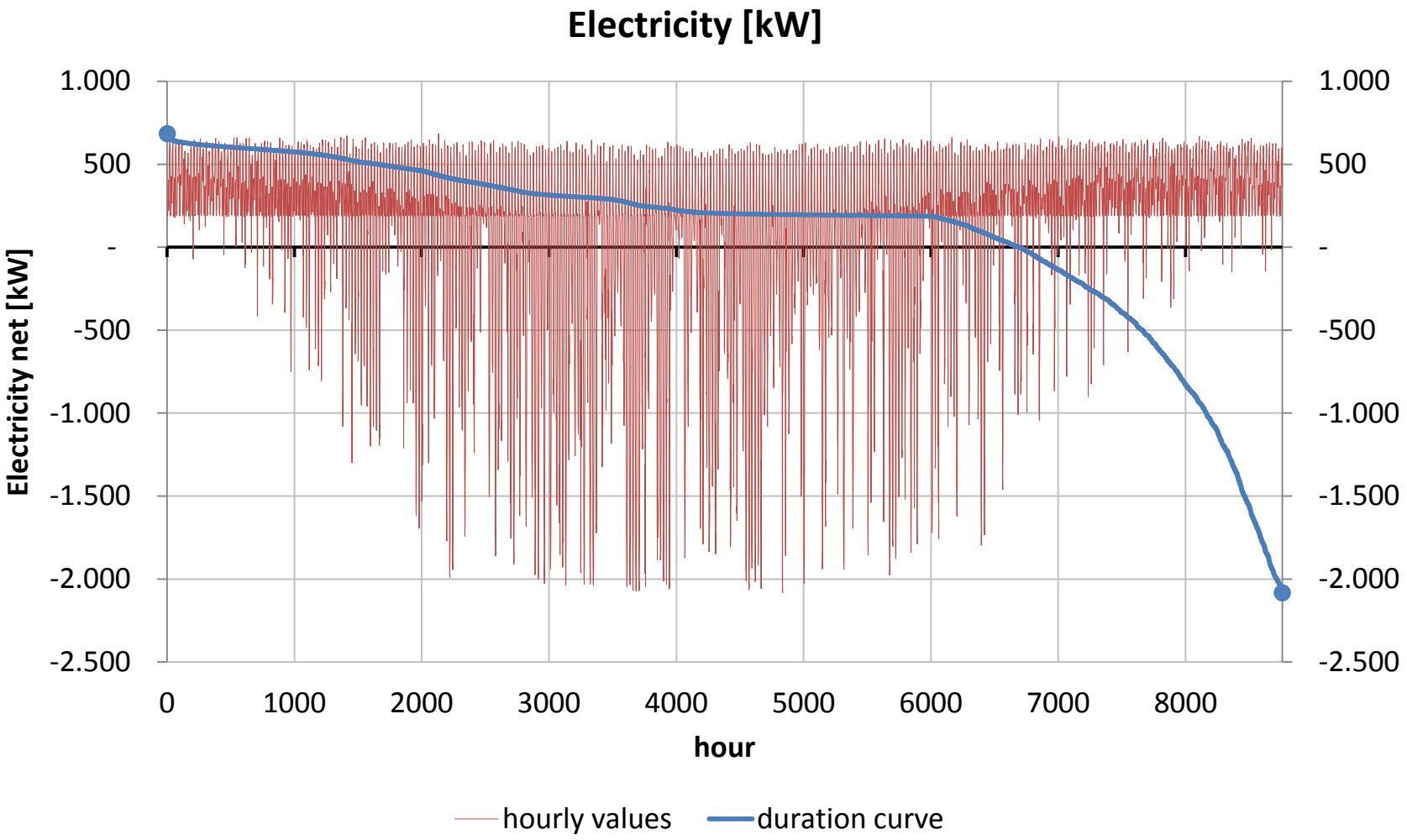
* Assuming average dwelling size of 119 m2 (SSB)

** Equivalent, calculated a posteriori

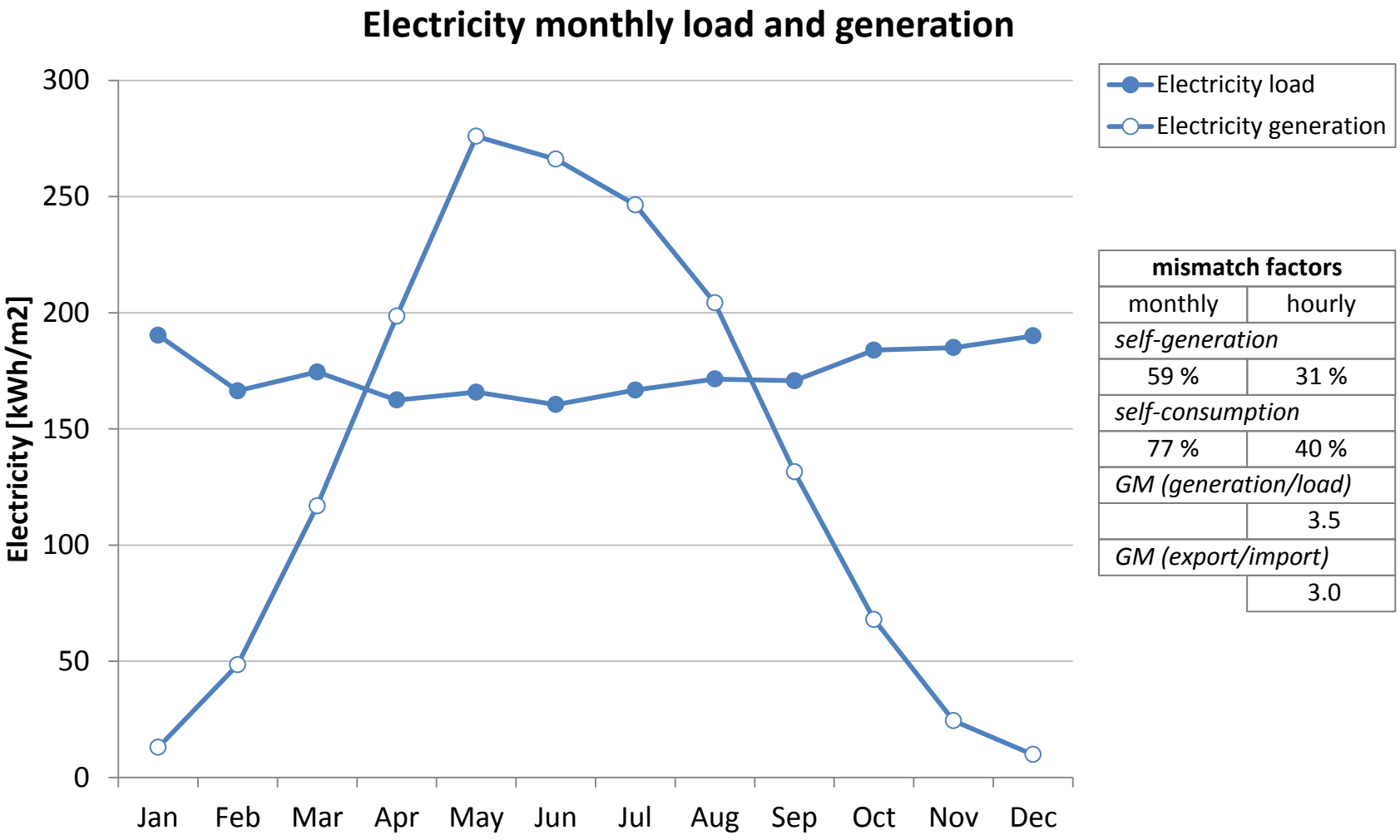
Electric demand – Non-residential buildings



Electric demand – Total ZVB



Electric demand – Total ZVB



mismatch factors	
monthly	hourly
self-generation	
59 %	31 %
self-consumption	
77 %	40 %
GM (generation/load)	
	3.5
GM (export/import)	
	3.0

Content

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Thermal demand – Method

- Calculations with dynamic simulation tool (IDA-ICE)
- Simplified geometry to contain computational time
- Hourly electric profiles as input
- Passive house building standard

Passive house – main parameters

Parameter	Value	Unit	Note
U-Value walls	0.14	W/m^2K	350mm insulation
U-Value roof	0.09	W/m^2K	350mm ins. lightweight
U-Value ground	0.11	W/m^2K	Equivalent, connsidering unheated basement
U-Value windows (glass)	0.8 (0.7)	W/m^2K	20% insulated wood frame
% window area/BRA	20	%	60% South, 40% North
Air-tightness	n_{50} = 0.5	ach	
Thermal bridges	0.03	W/m^2K	
Vent. heat recovery η	80	%	Min. exhaust T = 5°C
SFP (Specific Fan Power)	1.25	$kW/(m^3/s)$	
Low temperature system	45	°C	Dimen. T space heating @ -20°C T_{supply} ventilation heating battery

Domestic Hot Water (DHW)

	NS3031/NS3700 (delivered)	NVE* (delivered)
DHW	30 kW/m^{2}y	22 kW/m^{2}y

	ZVB simulation (need)	Sweden – 1300 dwellings (need)	Finland – 180 dwellings (need)
DHW	0.41 m^3/m^{2}y (61 l/pers.day)*	0.41 m^3/m^{2}y (61 l/pers.day)*	0.29 m^3/m^{2}y * (43 l/pers.day)

* Assuming Norwegian average dwelling size of 119 m2 and 2.2 pers/dwe (SSB)
Note: there can be significant differences in the choice of reference floor area between countries

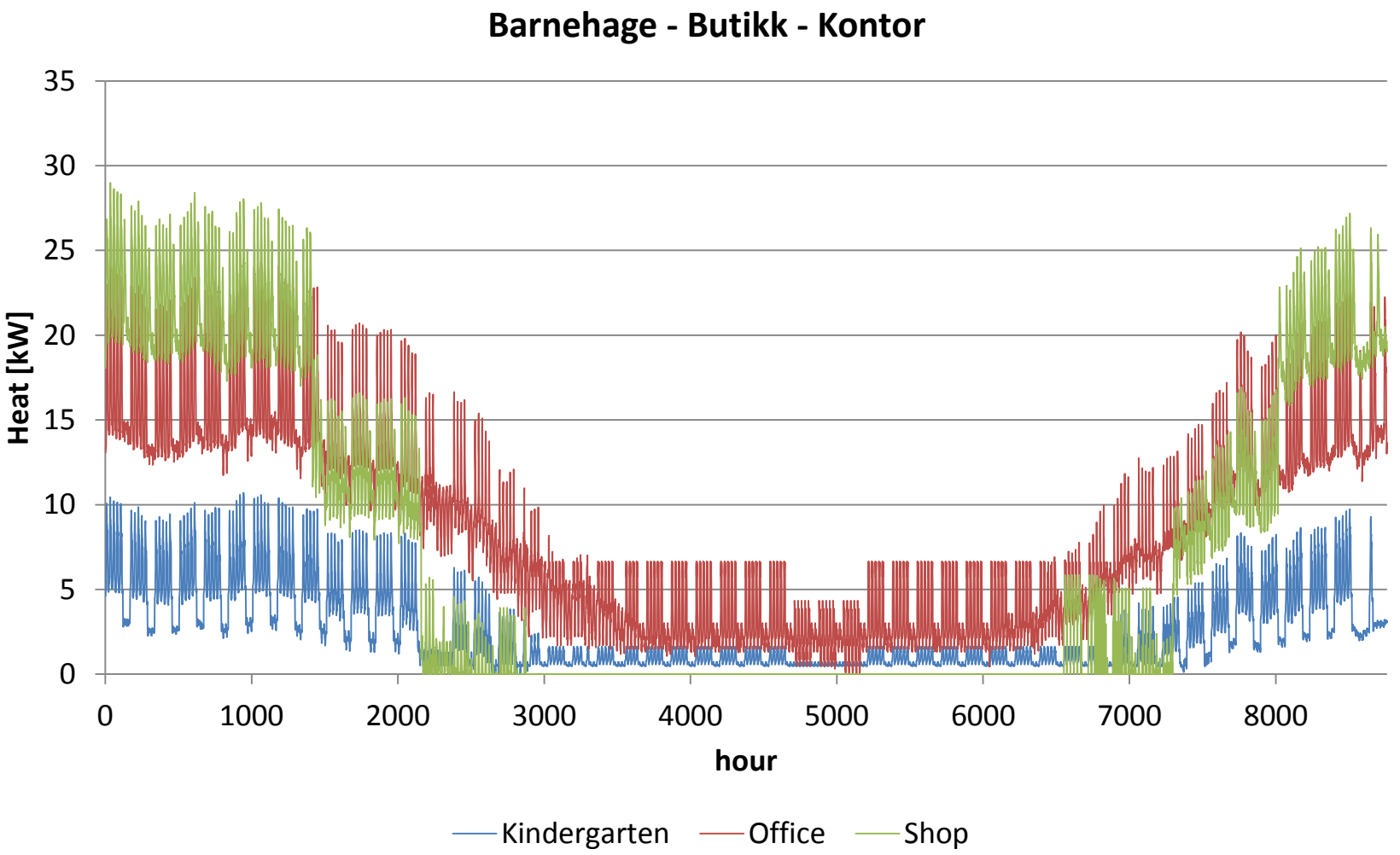
+ DHW storage and distribution losses (from TABULA EU-project):

- Small house = 1 kWh / m^{2}y
- Apartment = 3 kWh / m^{2}y (circulation)

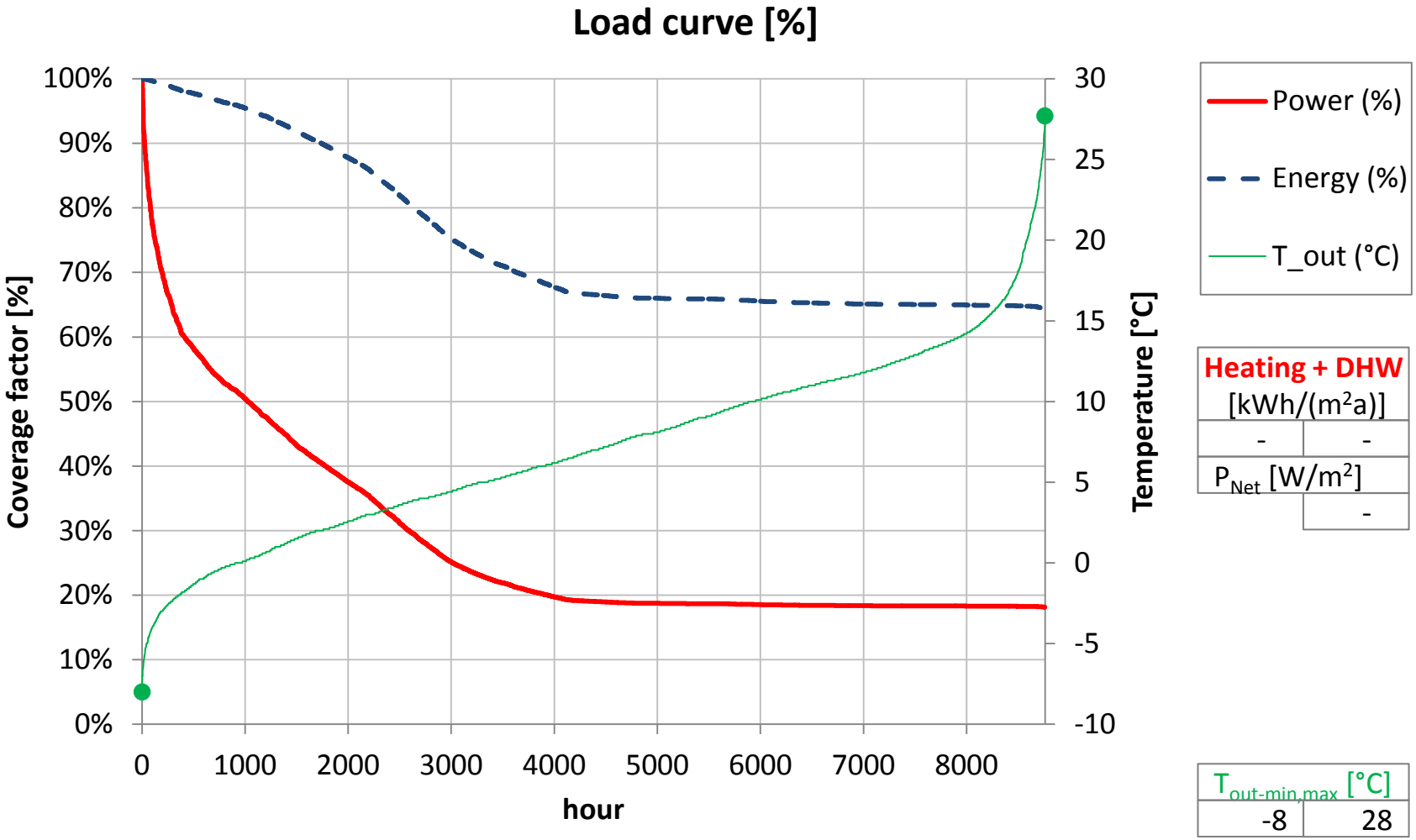
Results – Overview

Energy service	Value [kWh/m²y]	
	Row houses	Apartments
Heating (incl. 10% losses)	11.9	10.4
Space	10.0	8.3
Ventilation	1.9	2.1
DHW	23.4	25.4
Fans and pumps	3.6	4.2
Lightning	7.6	7.7
Plug loads	18.5	18.6
Total	65.0	66.3

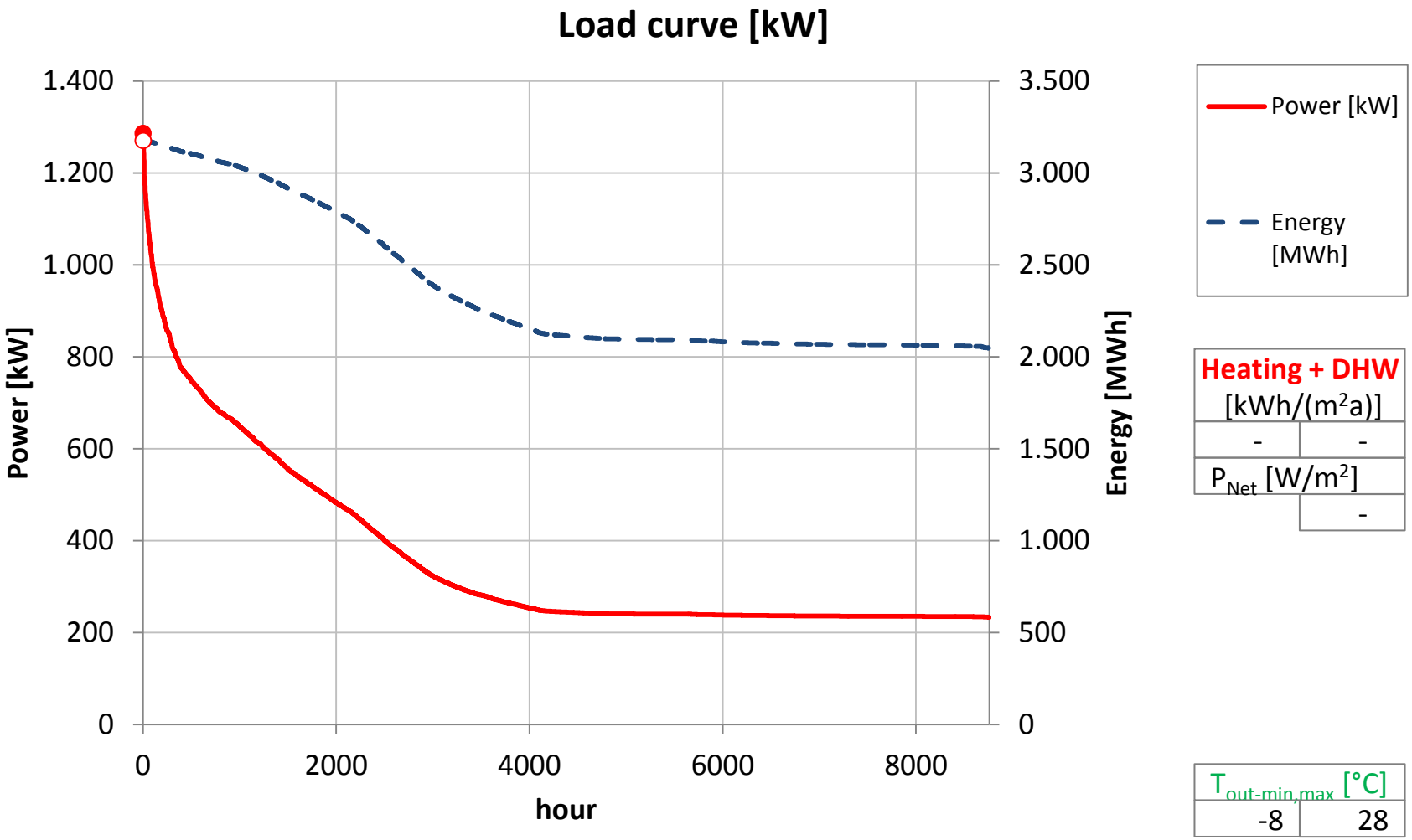
Thermal load– Non-residential buildings



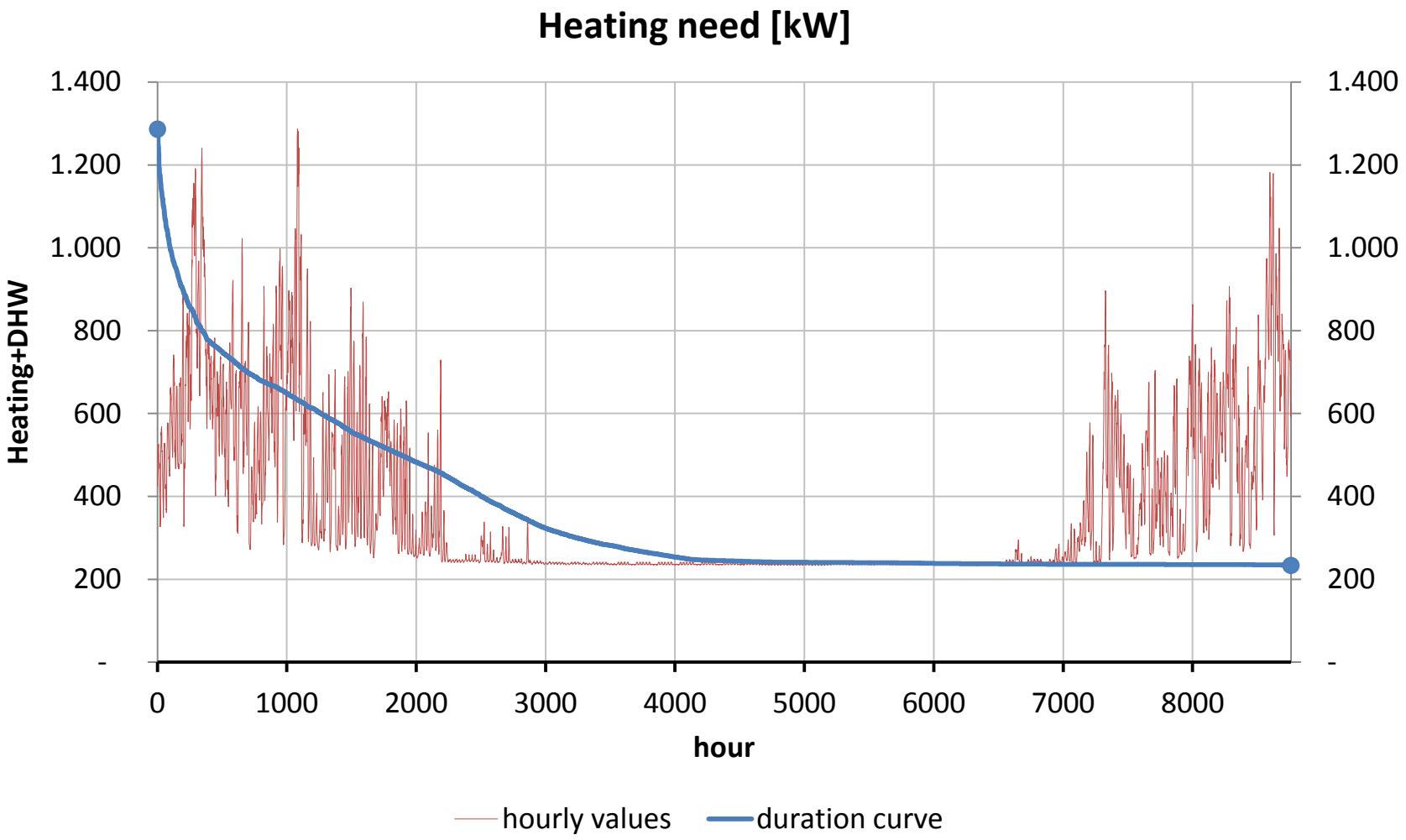
Thermal load – Total ZVB



Thermal load - Total ZVB



Thermal load - Total ZVB



Content

- Background: Aggregated energy demand
- Electricity demand
- Heating needs
- **Summary**

SUMMARY Electric and Thermal

Electric demand– Total ZVB				
	Energy		Peak Power *	
Type	[kWh/y]	[kWh/m²y]	[kW]	[W/m²]
Klyngetun	1 849 000	29.8	449	7.2
Boligblokk	704 000	30.6	169	7.3
Total residential	*2 553 000*		*619*	
B/B**/K	705 000	104.8	137.9	20.5
Total ZVB	*3 257 000*		*684*	

Thermal need– Total ZVB				
	Energy		Peak Power *	
Type	[kWh/y]	[kWh/m²y]	[kW]	[W/m²]
Klyngetun	2 193 000	35.3	893	14.4
Boligblokk	824 000	35.8	355	15.4
Total residential	*3 017 000*		*1 248*	
B/B**/K	160 000	23.8	63	9.4
Total ZVB	*3 177 000*		*1 286*	

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* Hourly average; ** w/o food storage

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SUMMARY PV-Electric demand

PV generation [kWh/y] (Multiconsult)	Coverage	Self-consumption	Peak Power [kW]	
2 501 000			**Generation**	**Export**
Total residential	98 %	31 %	2 431 *(GM 3.9)*	2 204 *(GM 3.6)*
Total ZVB	77 %	40 %	2 431 *(GM 3.5)*	2 083 *(GM 3.0)*

What if…

- Night setback at 19°C?
  - Peak power (thermal) up by ~ 80% !!!
- T_{indoor} @ 24°C instead of 21°C?
  - Energy demand (for heating) up by ~ 100%
- Electric load @ 1min instead of 1hour resolution?
  - Peak power (electric) up by ~ 15%

Thank you! ☺

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