

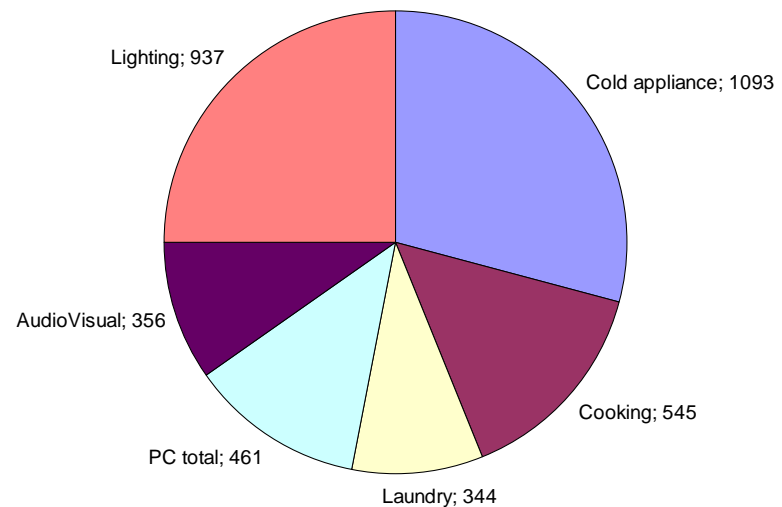
# End Use Metering in the Residential Sector

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- Method
- What went wrong
- What could we have done better
- End results



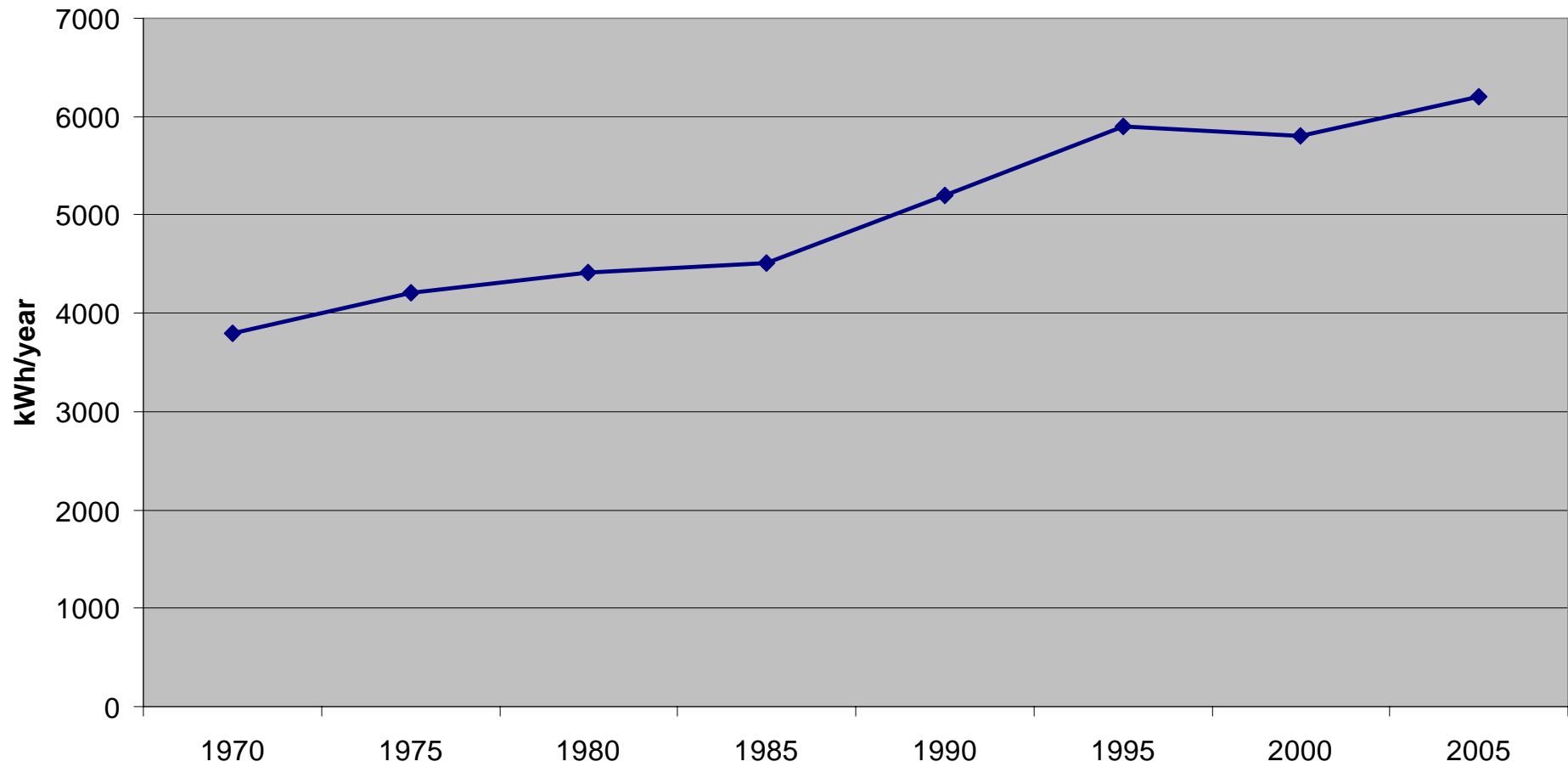


## Sources for energy statistics in buildings in Sweden

- Statistics Sweden- annual survey since 1973
- A net based database for reporting
- Commercial building audits
- Measurements in 390 households
- Measurements in 17 multifamily houses, electricity for the operation

The ELL energy audit program

Household electricity, one family houses, according to surveys by Statistics Sweden



# Why we did this

- Why is household electricity increasing?
- How is electricity used? (per appliance)
- Trends for appliances
- Basis for a possible government program and information activities

# Timeplan

- 2003 prestudy
- 2004 test of two promising technologies
- 2005 Aug – 2008 July measurements
- 2008 – analysis

# The actors

- The Swedish Energy Agency, financing and overall project leader
- Main contractor, Enertech (France)
- Subcontractor, YIT installations Swedish
- Statistics Sweden sampling
- Researchers

40 measurements, 12 months  
350 measurements, 1 month

- Equipment per household;
  - 17.5 serial wattmeters
  - 15 wattmeters with ammeter pliers
  - 25 lampmeters,
  - 2 temperature sensors
- In total 46 measurement equipments
- 10 min logging

# Data handling

- From loggers to PC, Oscar by Eneritech
- For quality check and analysis Access and B-manage (Eneritech)
- From Eneritech to STEM during the measurement period B-manage and Excel
- At STEM from Access to SQL

# Measurement equipment

## **Serial wattmeter (by Enertech)**

Max 12 amps

Battery 400 days

Memory 1,3 years

Component measurements



## **Wattmeter with am pliers and Pulsmeter (by Enertech)**

Measurements at the main  
switchboard



# Installations



# Selection

- Families 26 -64
  - Couples without children 26 – 64
  - Couples without children 64 –
  - Singles 26 – 64
  - Singles 64 -
- 
- From Statistics Sweden database on buildings

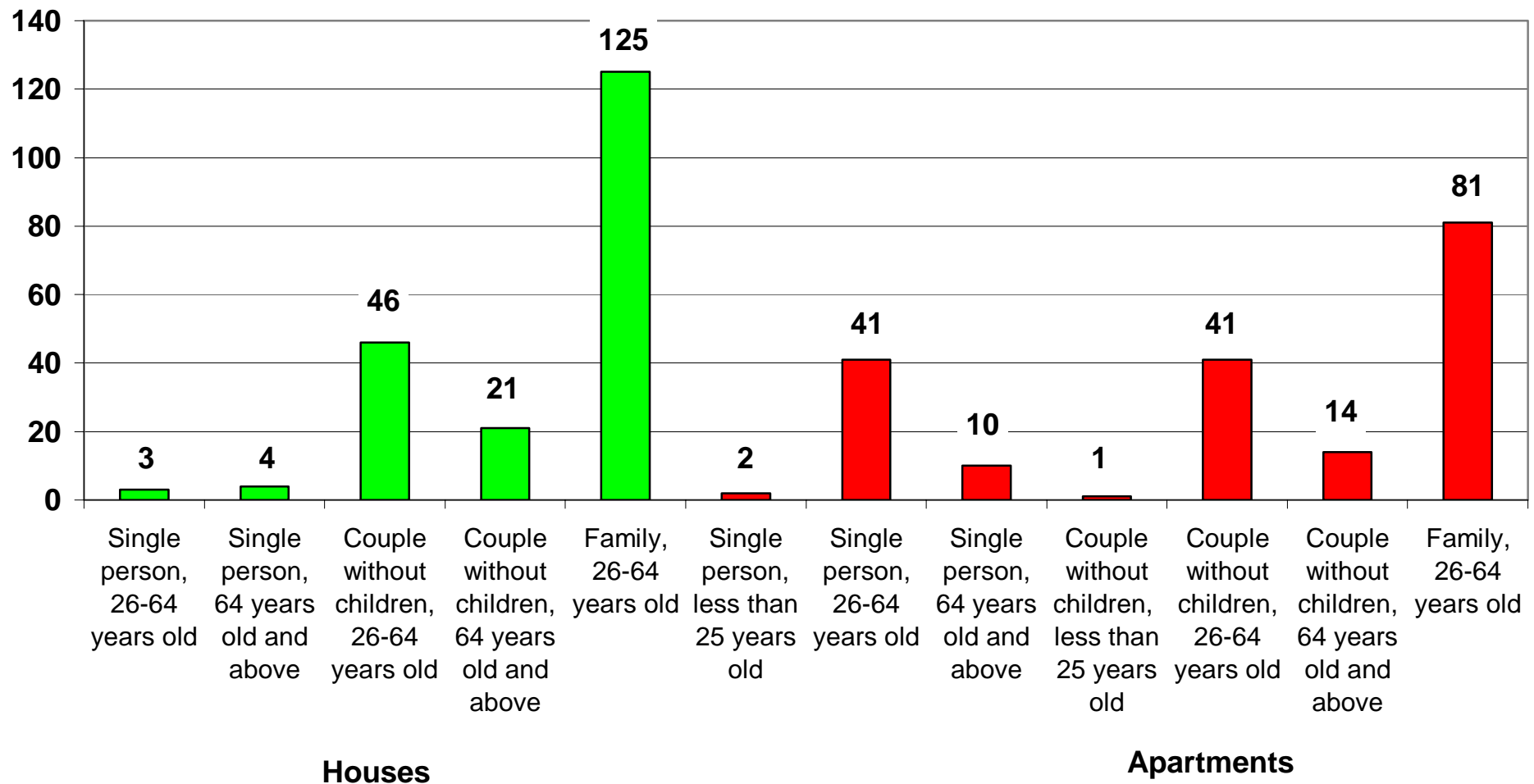


# What we ended up with

Swedish energy agency

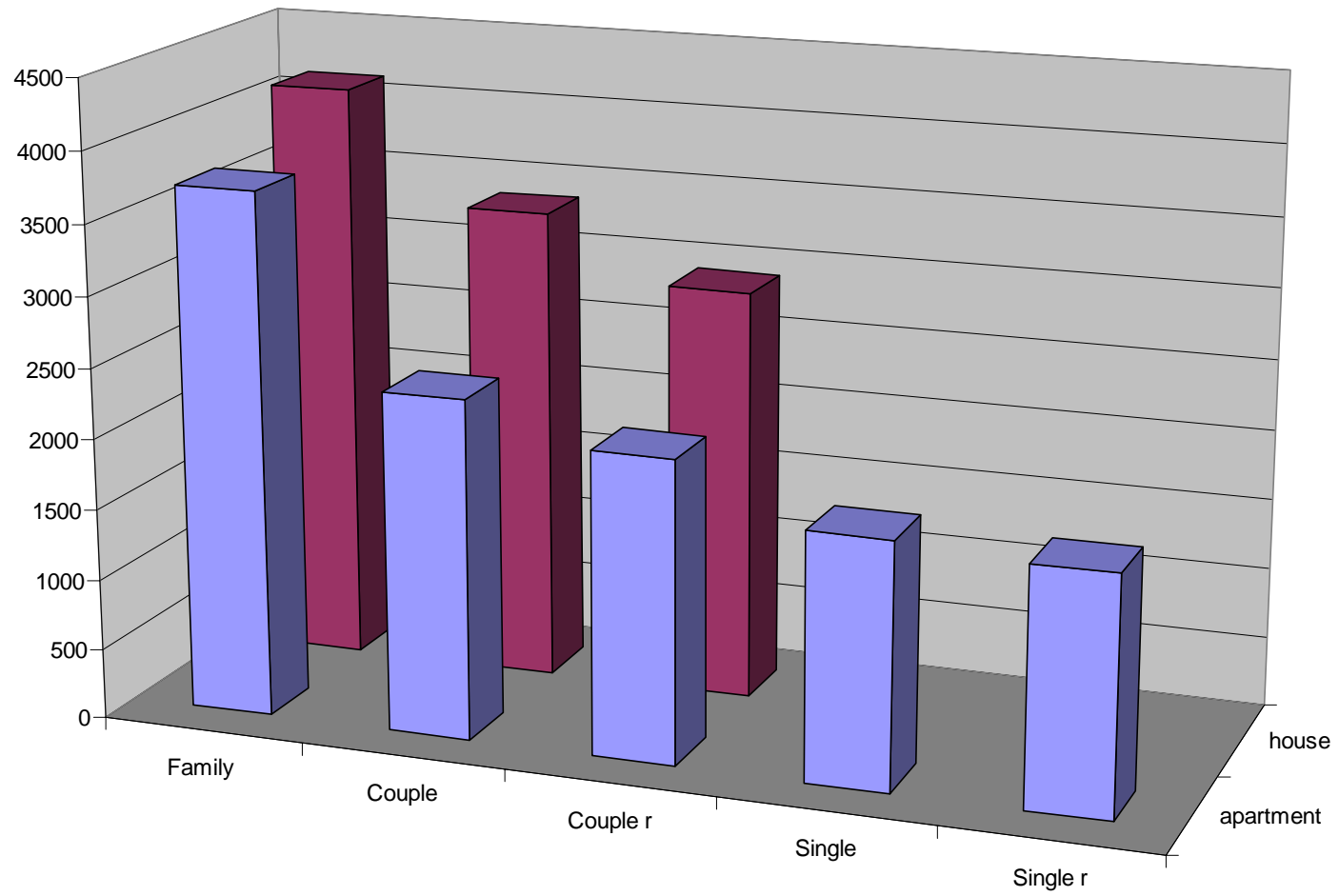
Enertech

## Characteristic of the sample Number of households per categories of inhabitants



	apartme nt	house
Family	3710	4143
Couple	2404	3358
Couple r	2139	2918
Single	1742	
Single r	1682	

Household electricity, kWh/dwelling



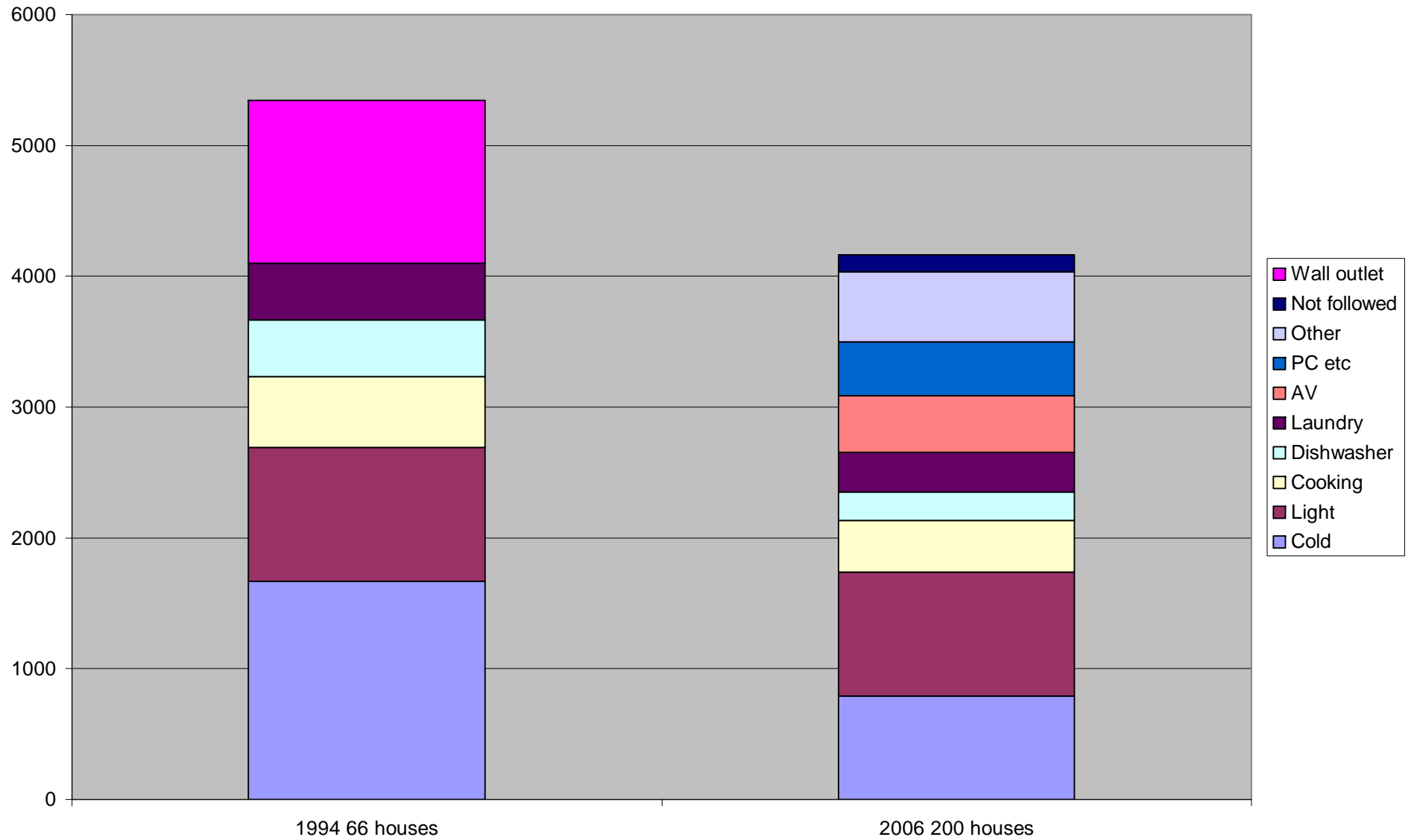
# Data handling

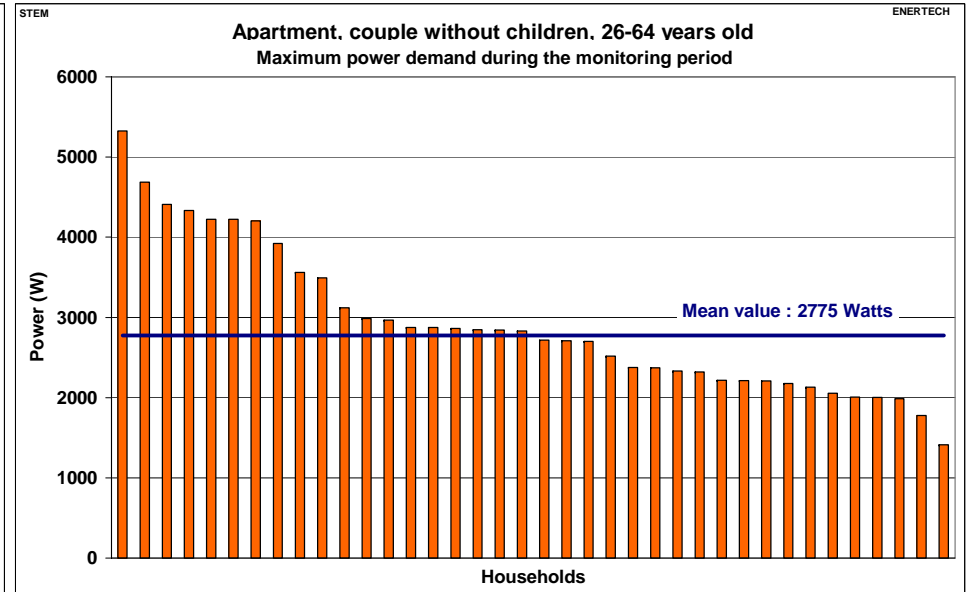
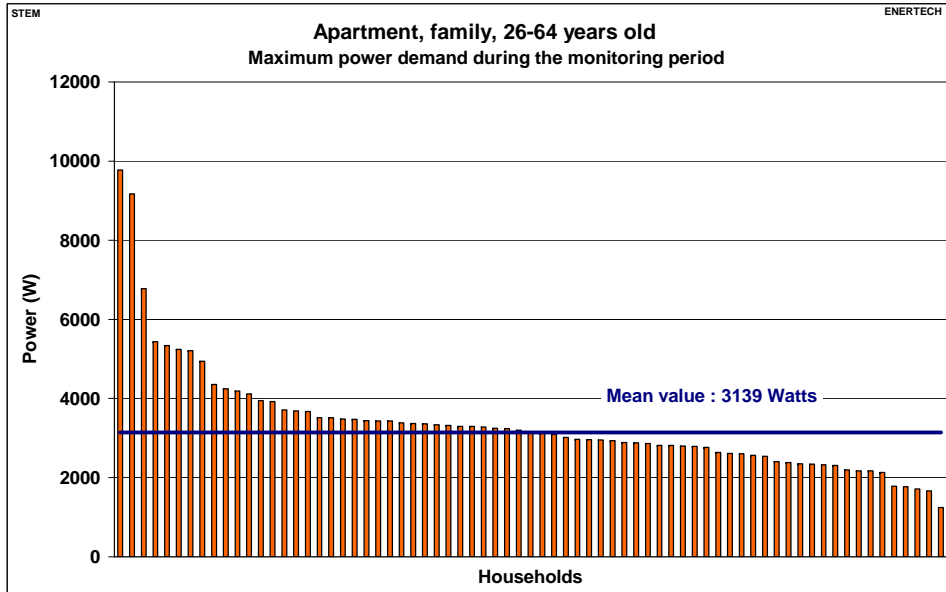
- The filtering and preparation was meticulous and took a very long time
- appliances monitored one month, 54 million data
- lighting monitored one month, 53 million data
- appliances monitored one year 55 million data
- lighting monitored one year 54 million data

# Costs

- Contractor administration & planning 29  
000€
- Measurement equipment 140  
000€
- Advice, control, installation 38  
000€
- Dismantling, equipment 14  
000€
- Analyses & reporting 187  
000€

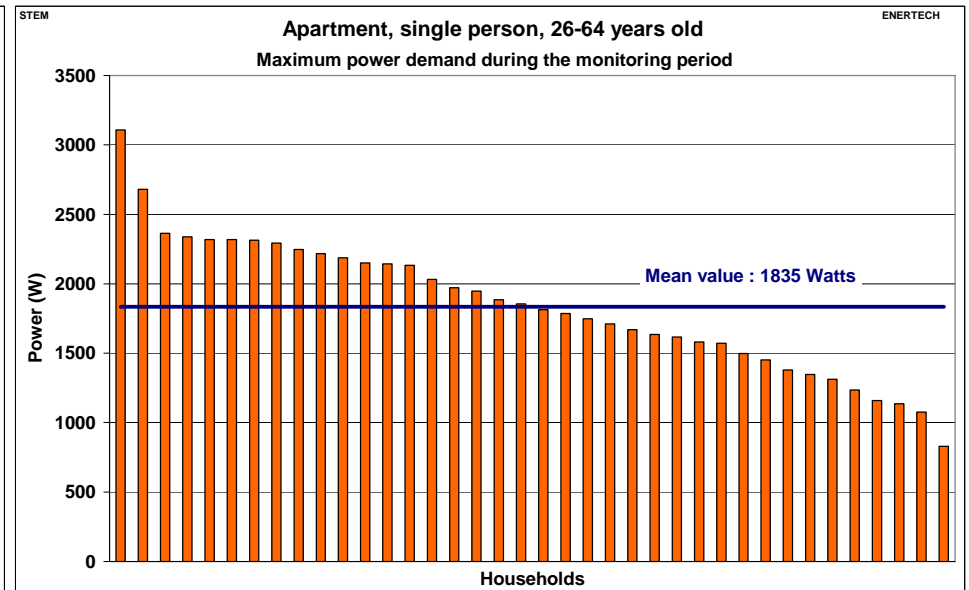
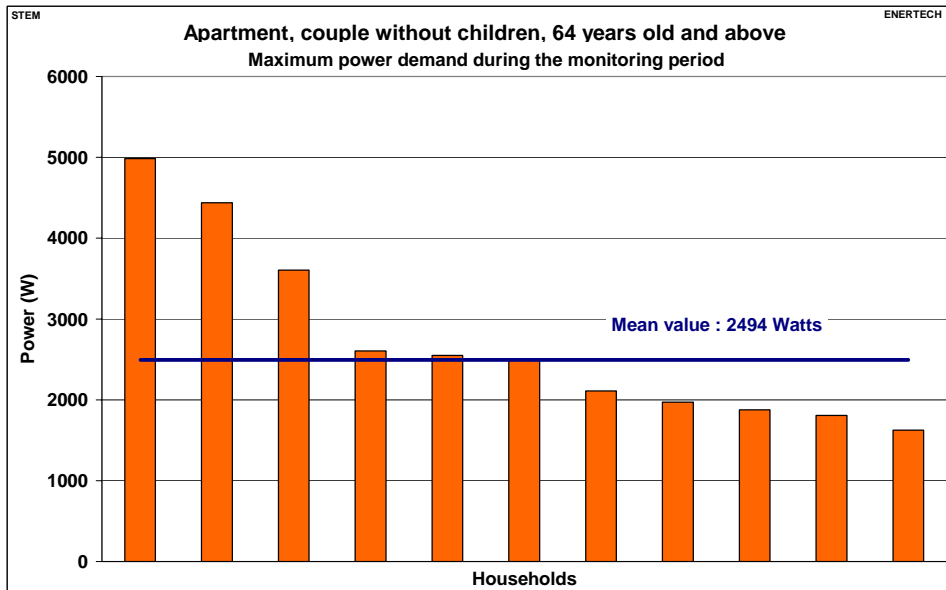
# The efficiency increase





Power consumers

Not so much power consumers



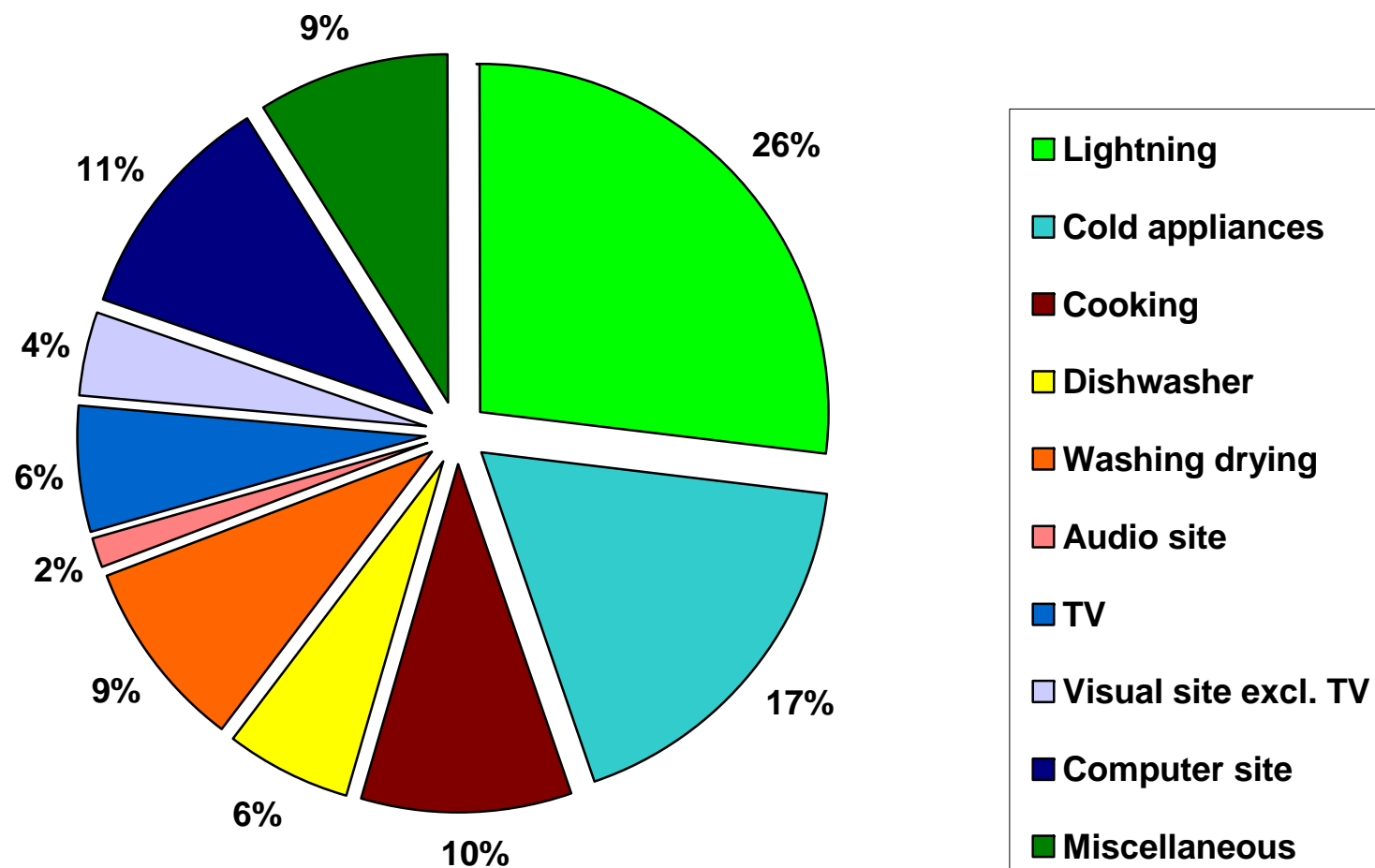
	<b>Average maximum power demand reached during 20 % of the time</b>	<b>Average maximum power demand reached during 80 % of the time</b>	<b>Average power exceeded during 1% of the time</b>
Apartment, couple without children, 26-64 years old	207	422	2672
Apartment, couple without children, 64 years old and above	128	273	3205
Apartment, family, 26-64 years old	295	558	3131
Apartment, single person, 26-64 years old	163	267	2260
Apartment, single person, 64 years old and above	142	227	2347



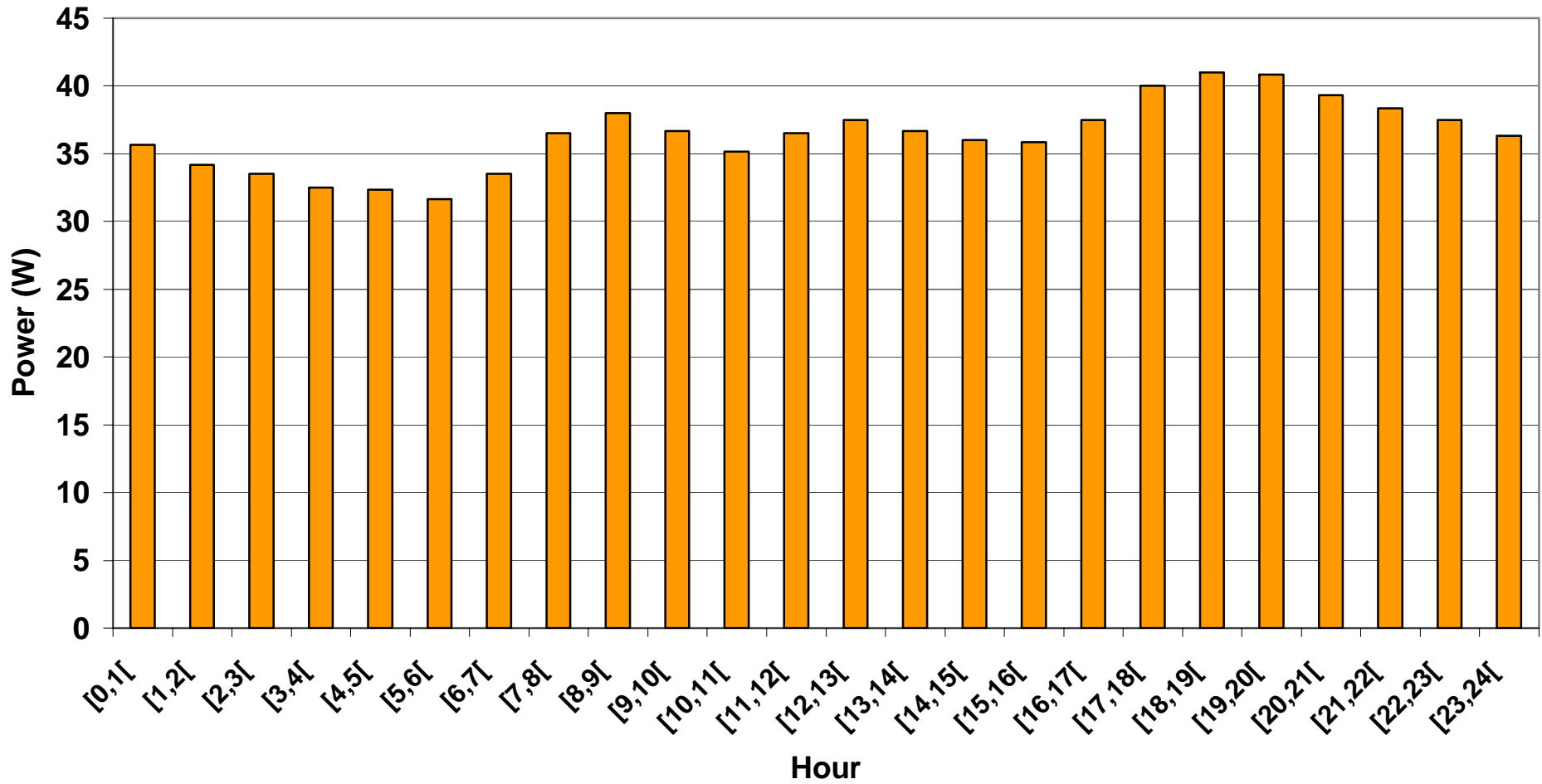
## Relative contribution from the different loads - Specific consumption

House, family, 26-64 years old, with direct electric heating

*All days*

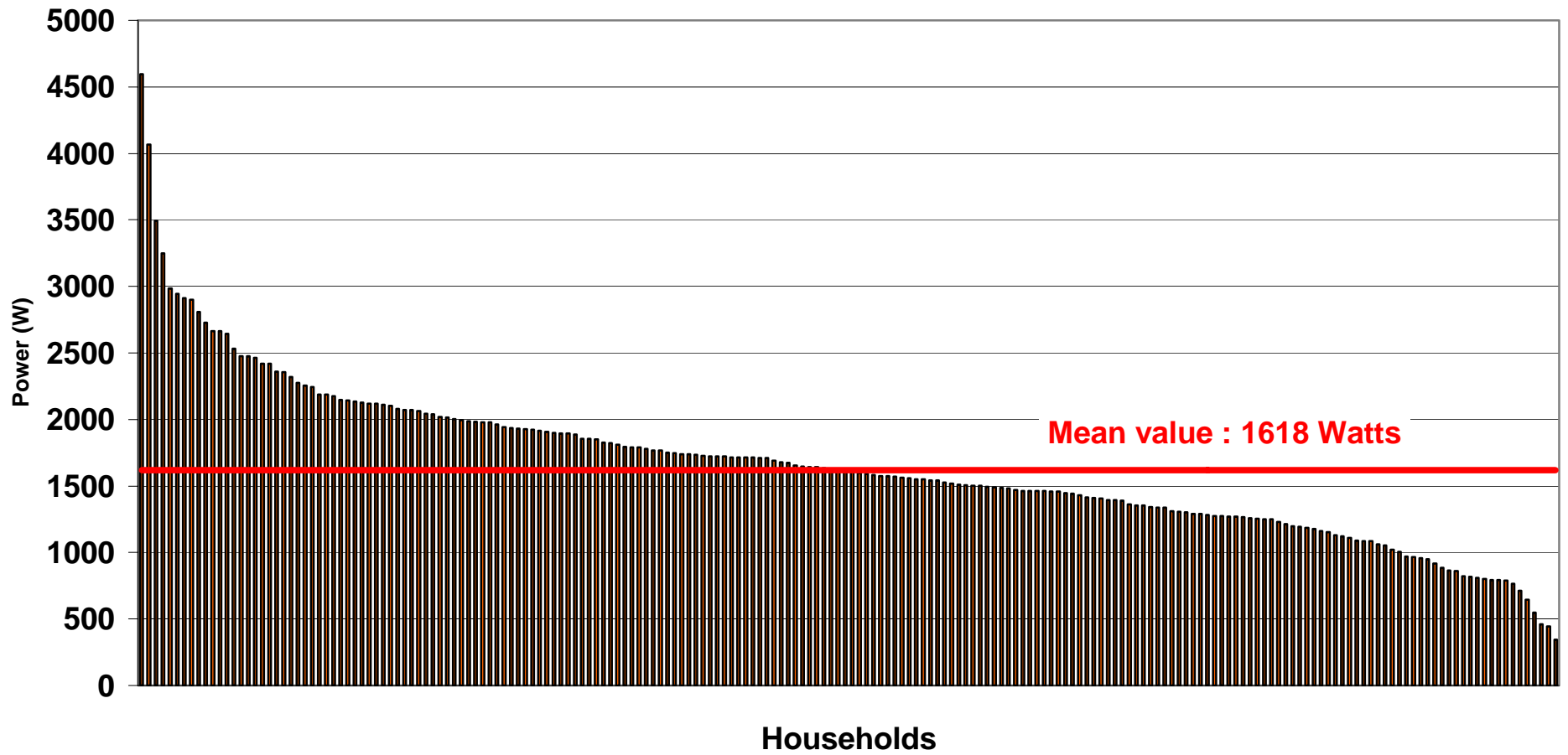


### Fridge Daily average load curve for apartments

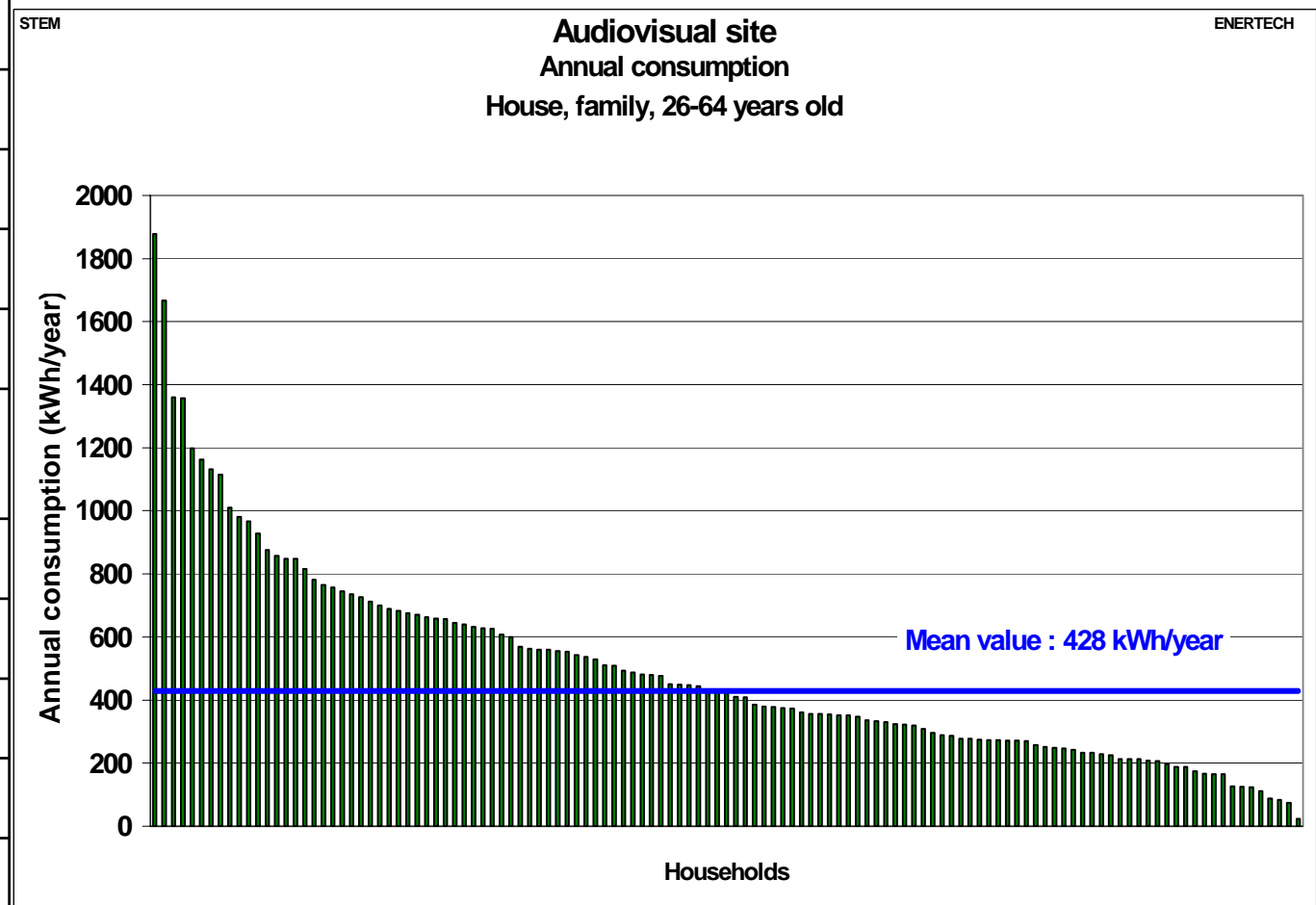


# Lighting

Average value of the installed lighting wattage  
Houses

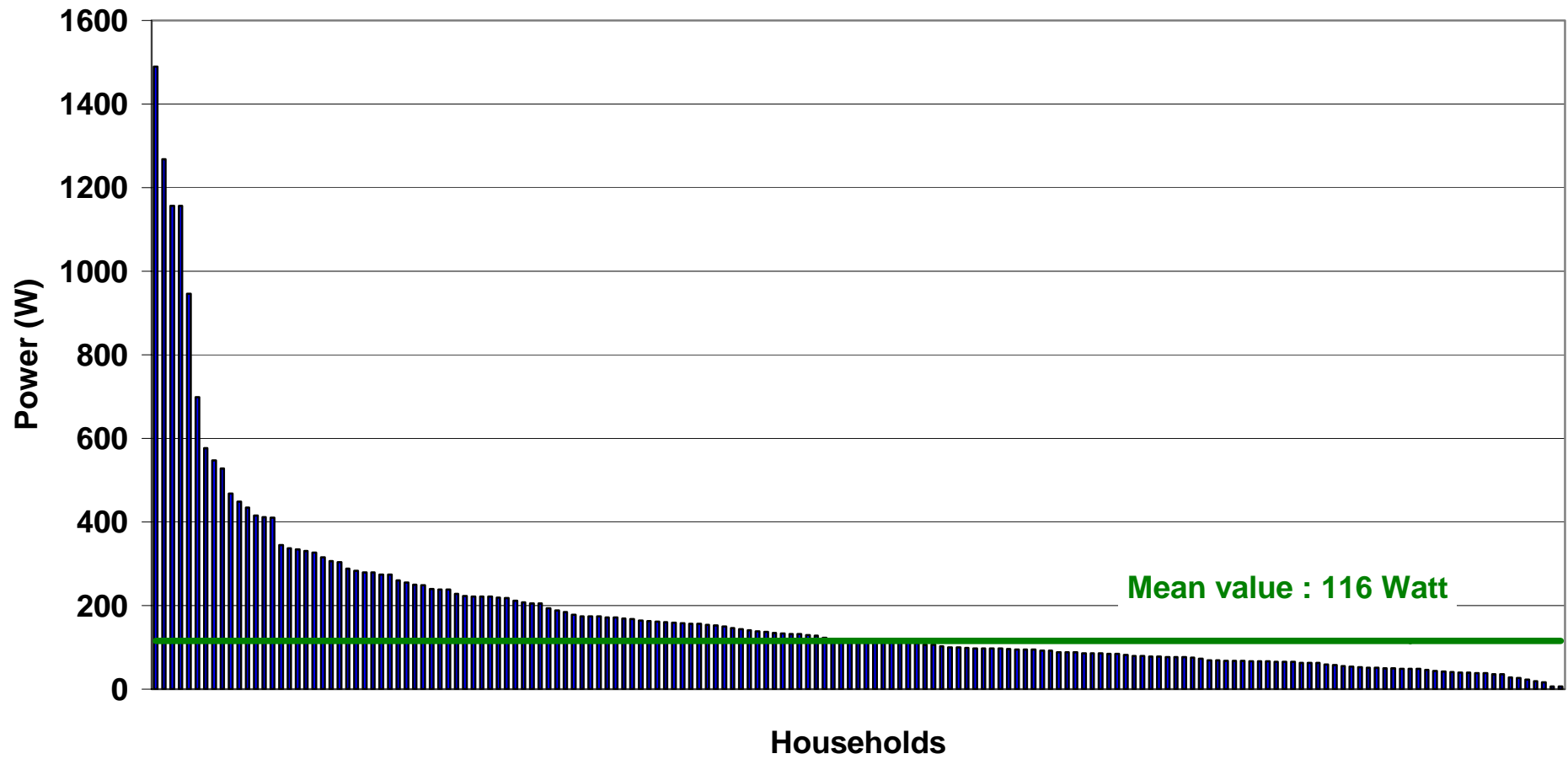


Device	Houses	Apartments
TV	2,11	1,52
Hi-fi	1,12	0,88
DVD player	0,98	0,73
VCR	0,83	0,72
Satellite	0,72	0,29
Home cinema	0,12	0,08
Xbox	0,05	0,02
Surround system	0,03	0,00
PS2	0,03	0,05
Projector	0,02	0,02
Cable TV Box	0,01	0,01
Playstation	0,01	0,02
Tuner	0,01	0,01



# Standby

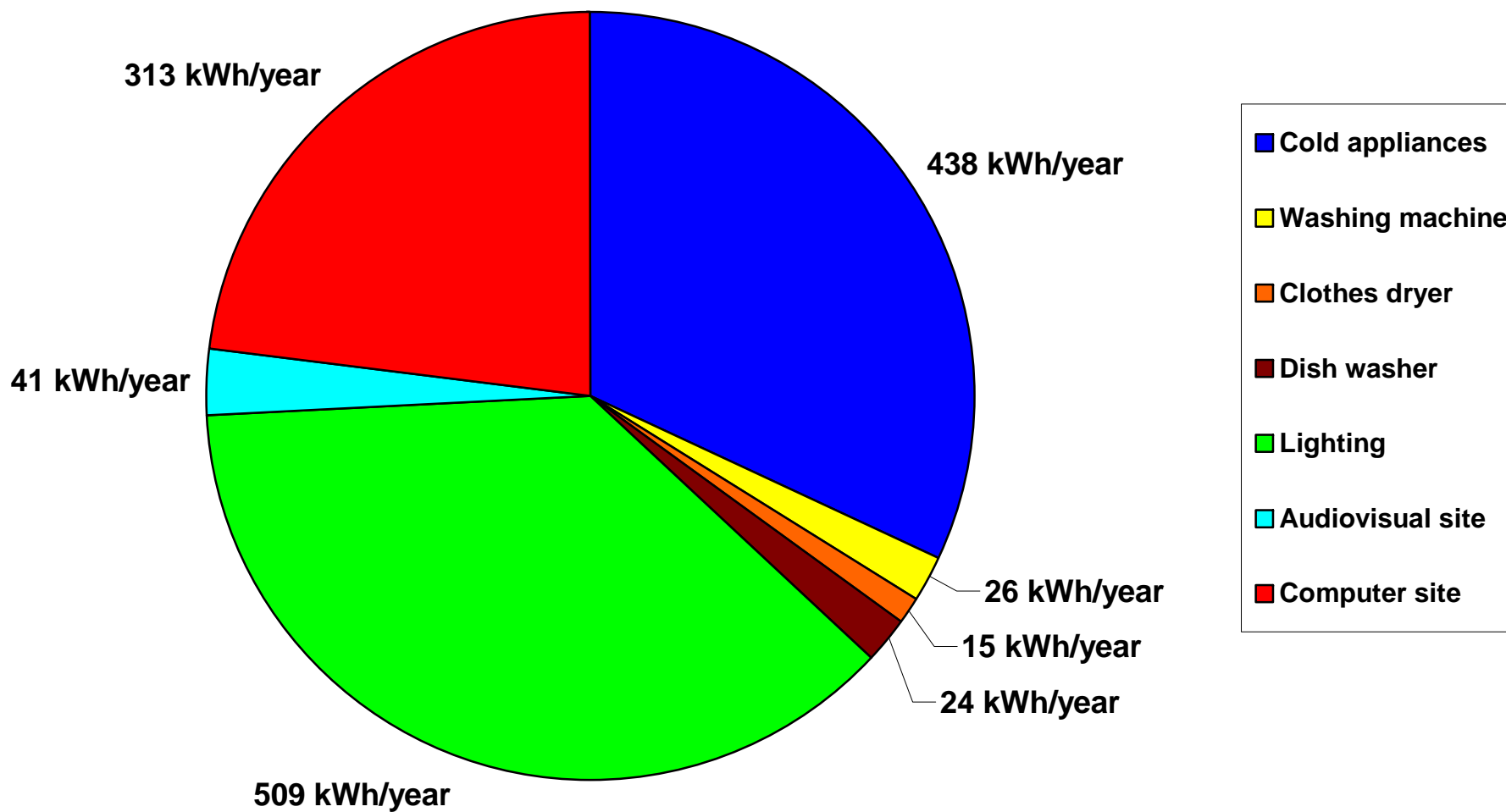
Standby power measured between 03:00 and 04:00  
All Houses



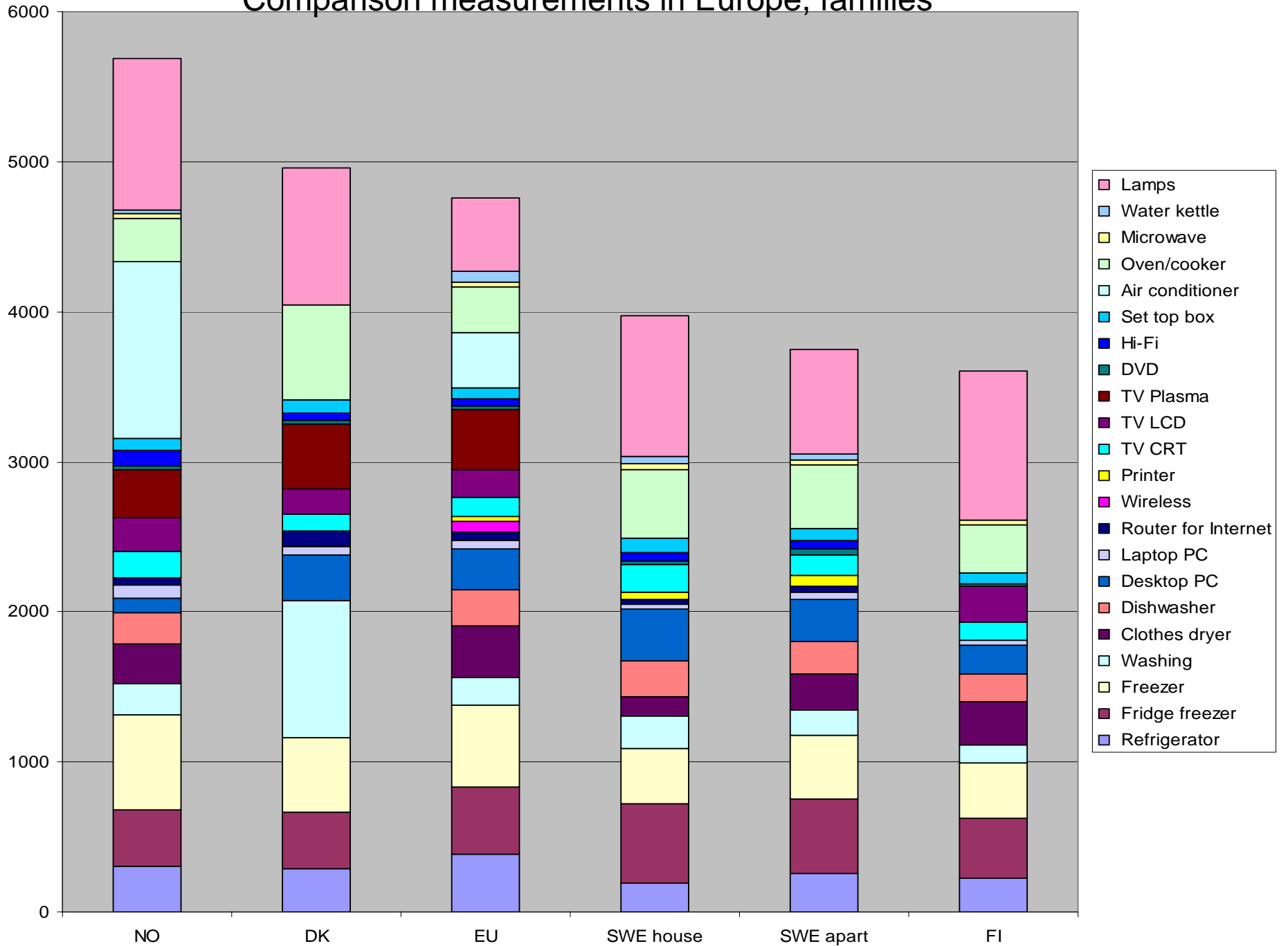
# Other

Appliance	Number of monitored appliances	Annual consumption (kWh/year)
Air dryer	4	585
Aquarium	23	230
Roof fan	2	203
Water bed	8	140
Alarm	5	140
Car heater	21	100
Fan	29	97
Solarium	1	88
Sauna	20	82
Air cleaner	5	67
Oxygen mask	3	61
Central vacuum cleaner	26	35
Copier	6	38
Typewriter	1	38
Clock radio	1	32
Kitchen ventilation	255	25
Shoes dryer	2	19
Radio	99	11
Hair dryer	1	7
Model train	1	7
Jacuzzi	13	6
High pressure washer	1	4
Calculator	3	3
Lawn mover	3	2
Sewing machine	1	1

### Repartition of the annual savings Apartment, family, 26-64 years old



# Comparison measurements in Europe, families



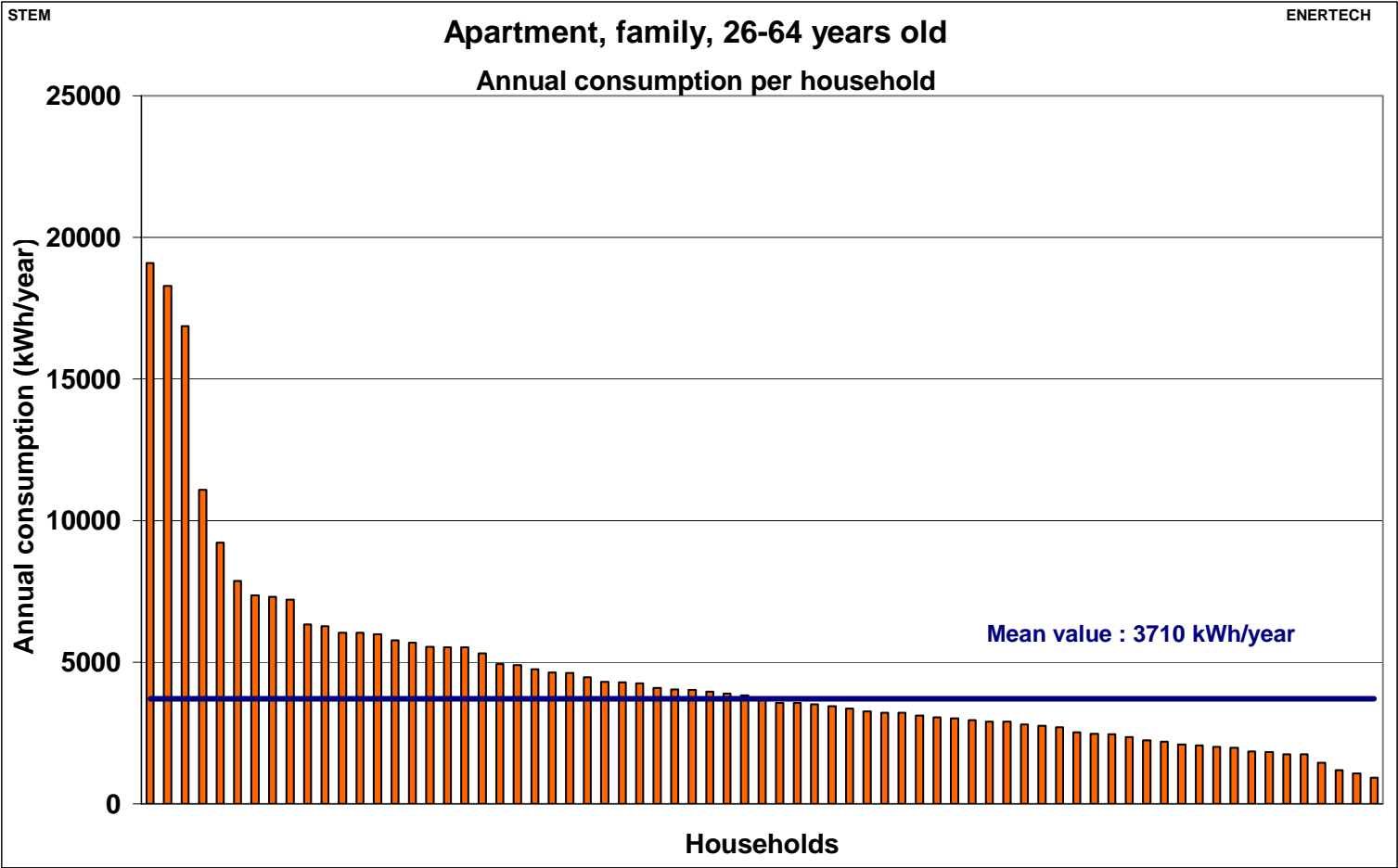
# What went wrong

- Selection process
- Dificult to find volunteers
- Database
- Measurement equipment - quality control
- To high "not measured" in apartments

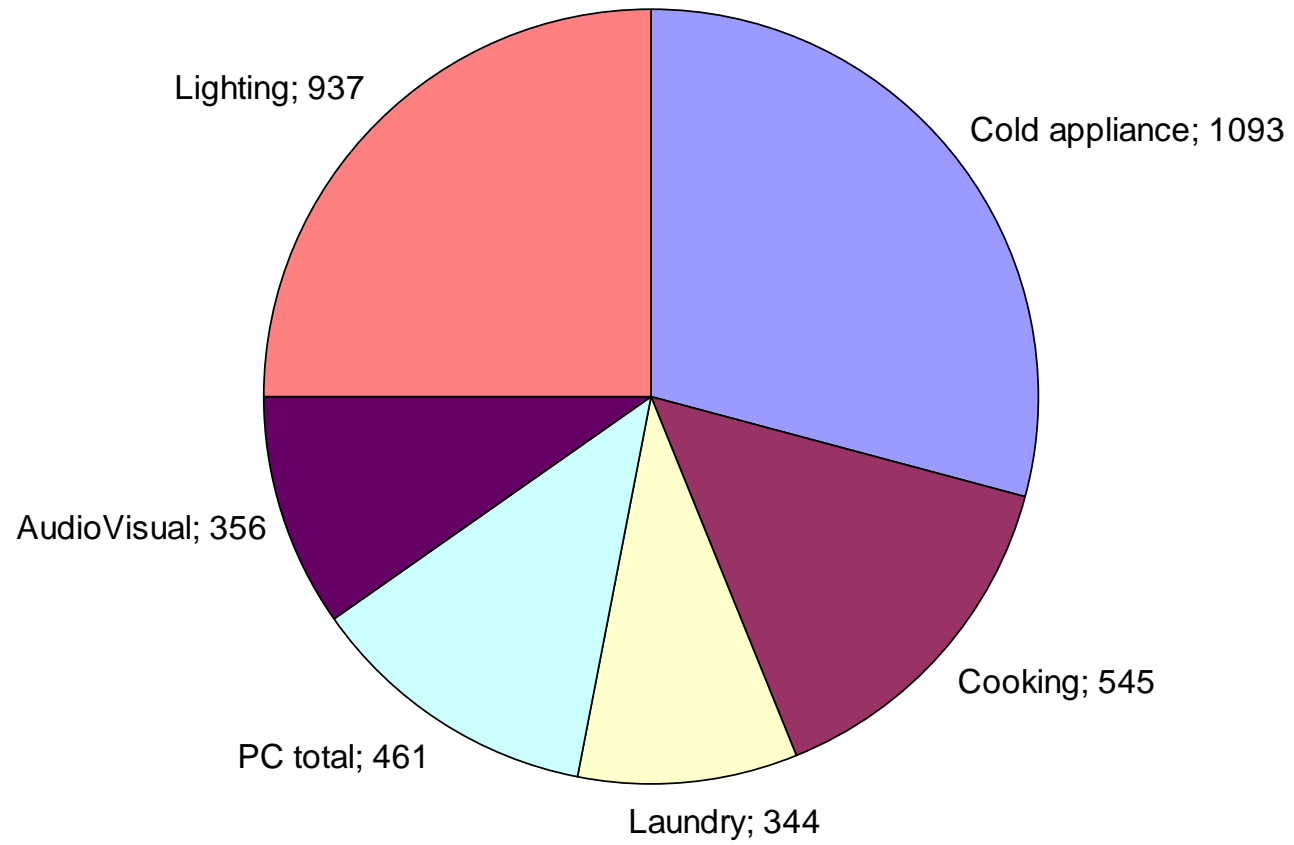
# Issues

- Consider the end use of data before starting
- Quality control from the start
- Database for both measurements and data from questionnaires (available on [www?](#)) SQL?

# Further analysis



# Swedish one family houses 4 000 kWh/year domestic electricity



# Further analyses

- Relationship appliance demand and EU labeling
- Lighting
- DHW
- Surveys and measurements - possible combinations
- Income and energy demand
- From 390 to national level
- Missing data how to replace?
- Indoor climate and energy demand (not from this study)