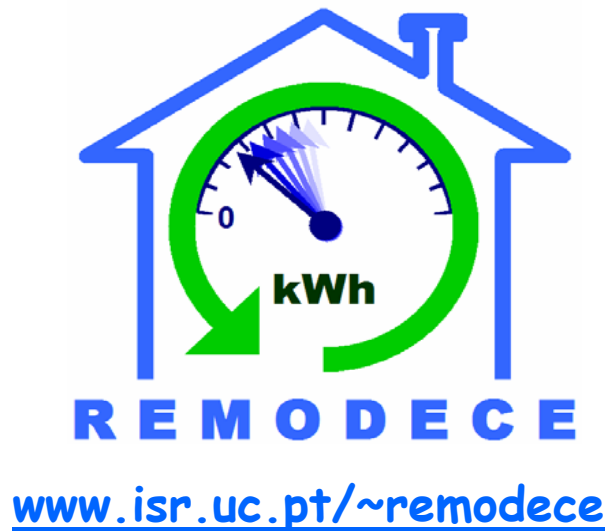


# Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe




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# Objectives of the project



- ❖ Contribute to an increased understanding of the energy consumption in the EU-27 households for the different types of equipment, including the consumers' behaviour and comfort levels;
- ❖ 12 countries are involved;
- ❖ To identify demand trends;
- ❖ Evaluation of the potential electricity savings that can already be implemented by existing means;
- ❖ Analysis of market transformation for different types of equipment;
- ❖ Policy recommendations for each type of equipment.



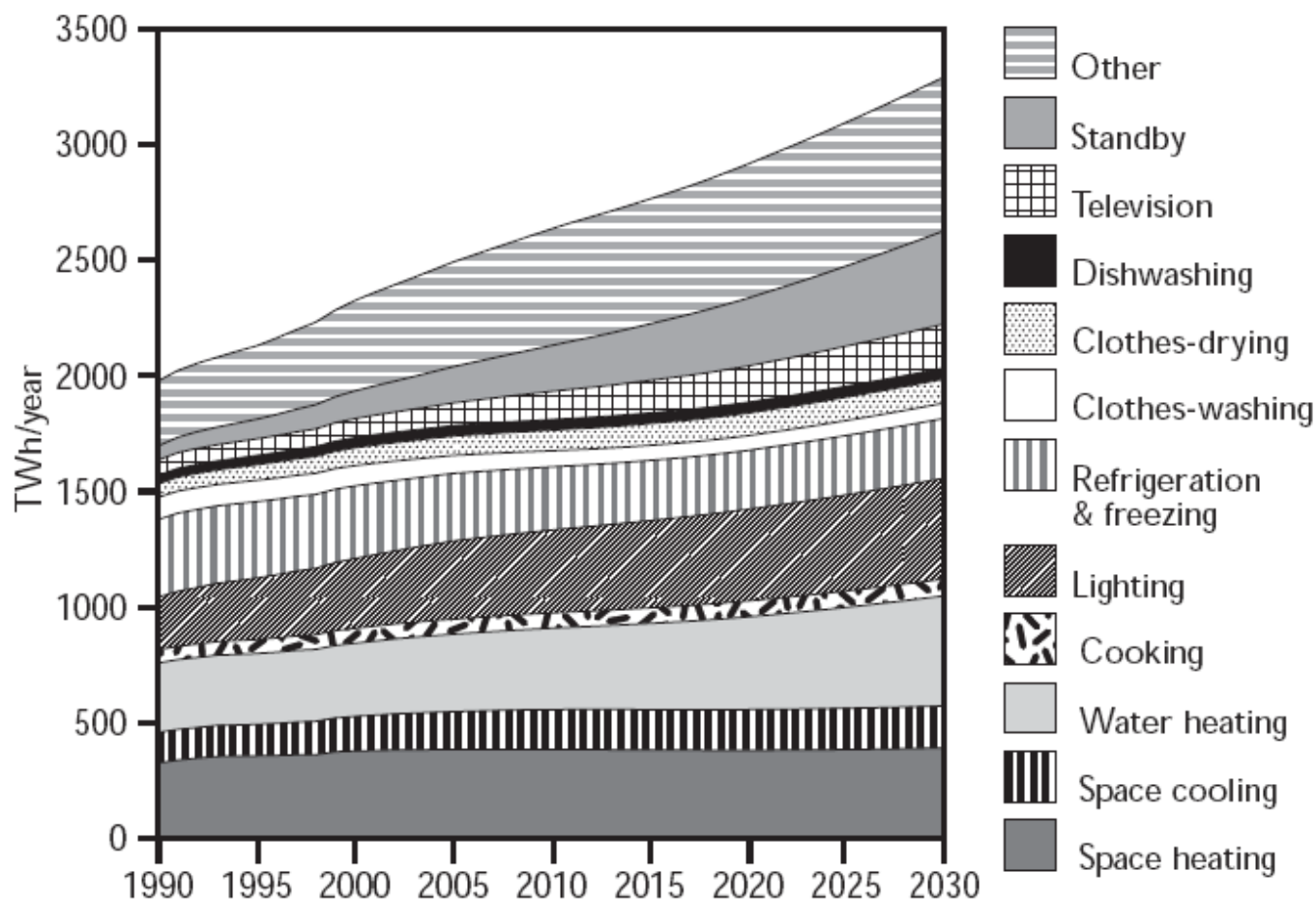
# Results of the project



- ❖ Updated European database on residential consumption, including Central and Eastern European countries;
- ❖ Innovative methodologies to combine the use of selective monitoring with wider-scale surveying;
- ❖ A user-friendly software tool to evaluate the energy performance of households;
- ❖ A set of policy recommendations for each type of equipment, which can lead to a successful market transformation and to provide cost-effective energy and carbon savings



# Projected IEA residential electricity consumption by end-use with current policies



# Harmonised Monitoring and Survey Methodology



- ❖ Analysis of already existing studies, surveys, metering campaigns, databases, statistics, manufacturer's information, market information, etc., on energy consumption in the residential sector, focusing end-use equipment, operating modes
- ❖ **Conducting households questionnaires (500 per country),** addressing user behaviour
- ❖ **conducting detailed audit in 100 households per country,** focusing demand load profiles in real situations.
- ❖ Conducting own measurements for a series of appliances/end-uses, especially to determine consumption in the standby and off modes of operation, because the available data is still relatively poor in this area.



# Monitored Loads

- ❖ In western European countries emphasis is placed in electronic loads and lighting
- ❖ In southern countries air conditioning loads are going to be investigated
- ❖ In eastern countries white appliances are also measured



# Definition of stand-by consumption



- ❖ **IEC 62301**: “House electrical appliances - Measurement of standby power”, published in June 2005, and its European on going transcription EN 62301.
- ❖ **Objective** : is to provide a testing method to determine the power consumption of a range of appliances and equipment in standby mode
  - The **standby mode** is the lowest power consumption mode which cannot be switched off (influenced) by the user.
  - The **standby power** is the average power in standby mode.



# Representativeness selection of households in Portugal



Guarantee of representative sample for the measurement and for the surveying campaigns => Database from the utility

- ❖ regional representativeness, covering four regions of Portugal with different climates and different standards of living
- ❖ structural criteria like: type of household, range of consumption





# Representativeness selection of households in Portugal



- ❖ Only customers with electronic telemeters installed are being considered for monitoring.
- ❖ Customers are selected based on the range of their annual electricity consumption:
  - Four main classes of consumption have been defined by the utility, and the number of customers in each range of consumption to be analysed has been weighted by the total consumption in the range.



# Monitoring equipment



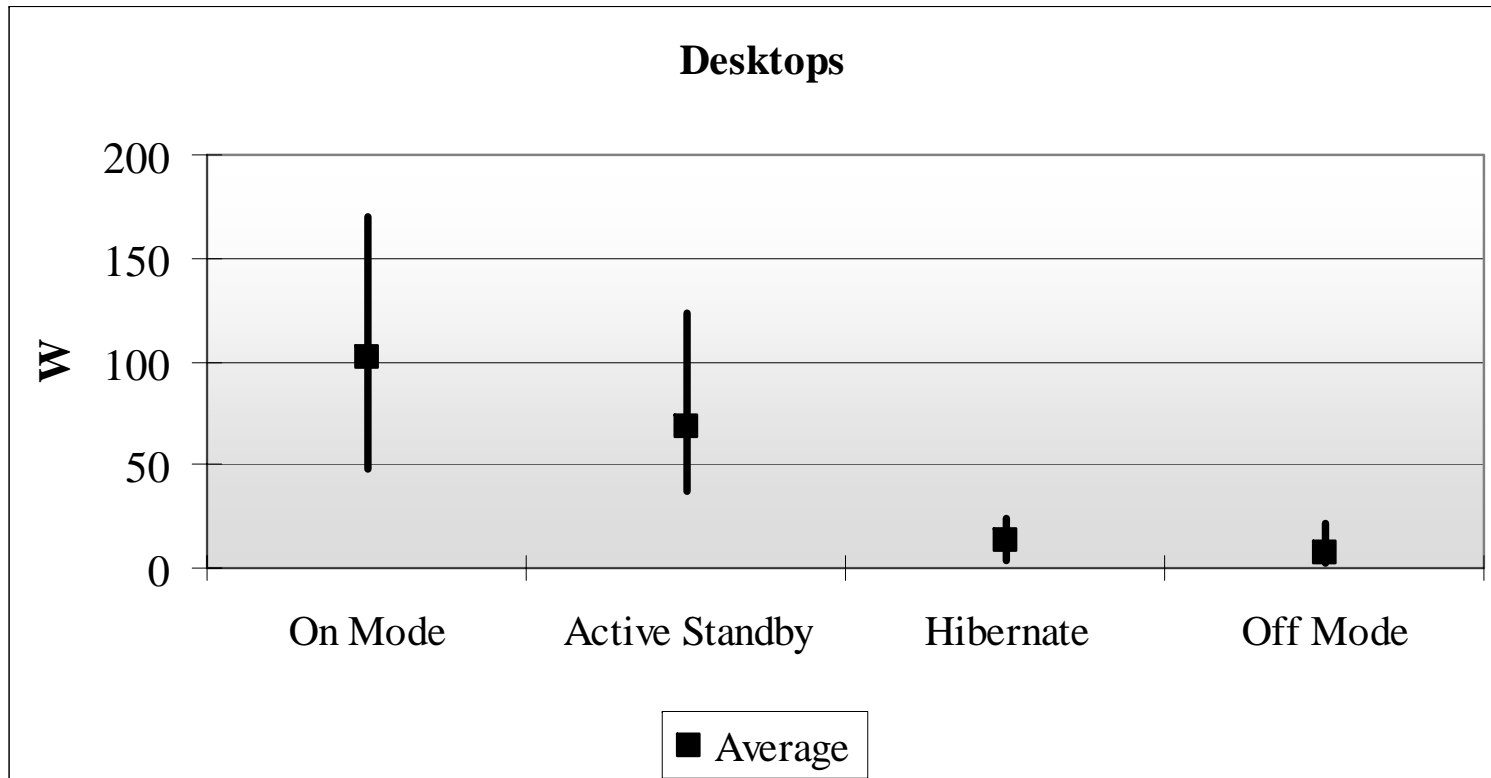
# List of loads to be monitored



- ❖ **total load electricity consumption** (mains supply): by telemetering, with a 10 min integration period
- ❖ **domestic computers and peripherals** (load of the sum of every set of appliances during two weeks, 10 min integration period, plus spot measurements of all appliances in every mode of operation)
- ❖ **new domestic entertainment electronic loads** as home movie systems, consoles, DVD players/recorders, plasma TVs, etc (load of the sum of every set of appliances during two weeks, 10 min integration period, plus spot measurements of all appliances in every mode of operation)
- ❖ **other stand-by power** (spot measurements)
- ❖ **lighting and air conditioning** (two weeks measurements, 10min integration periods)



# Power consumption of desktop PCs



**On mode:** normal operation, the device is carrying out main function.

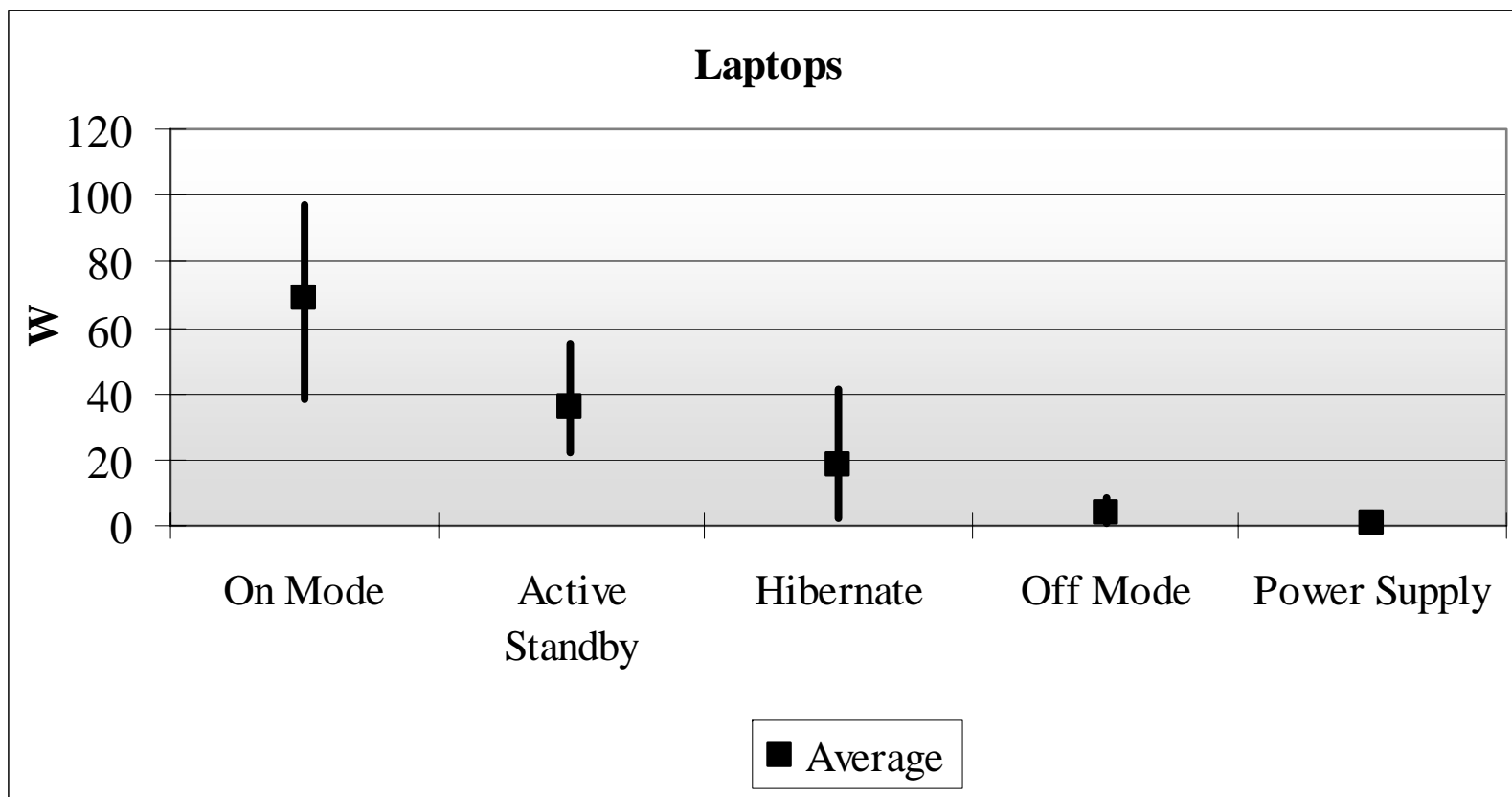
**Active Standby Mode:** Energy consumption is reduced; the device is able to awake very quickly.

**Hibernate/Sleep Mode:** Deep sleep mode, the device is suspend to disk; Energy consumption greatly reduced.

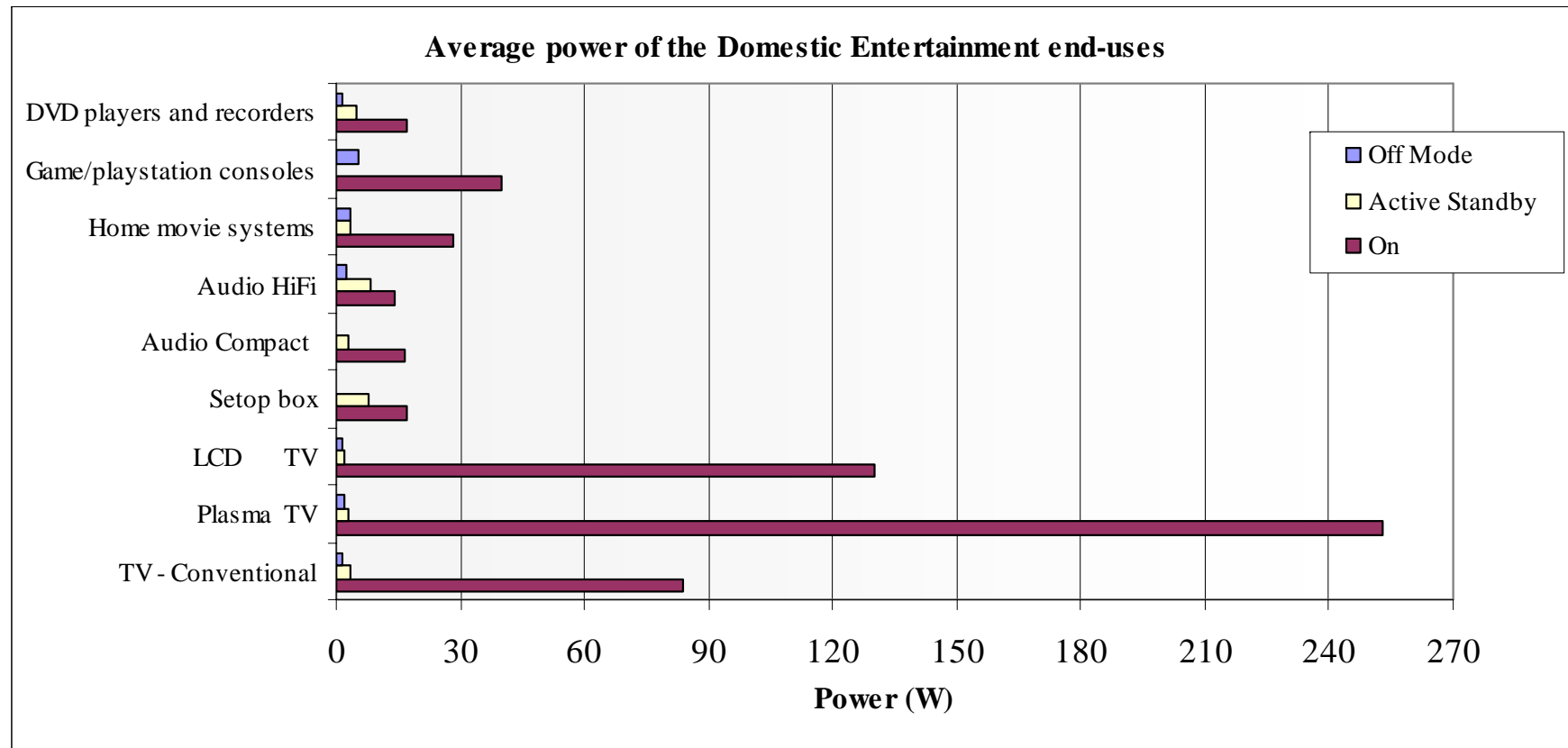
**Off-mode:** Device is not carrying out any function, seems to be off but is consuming energy



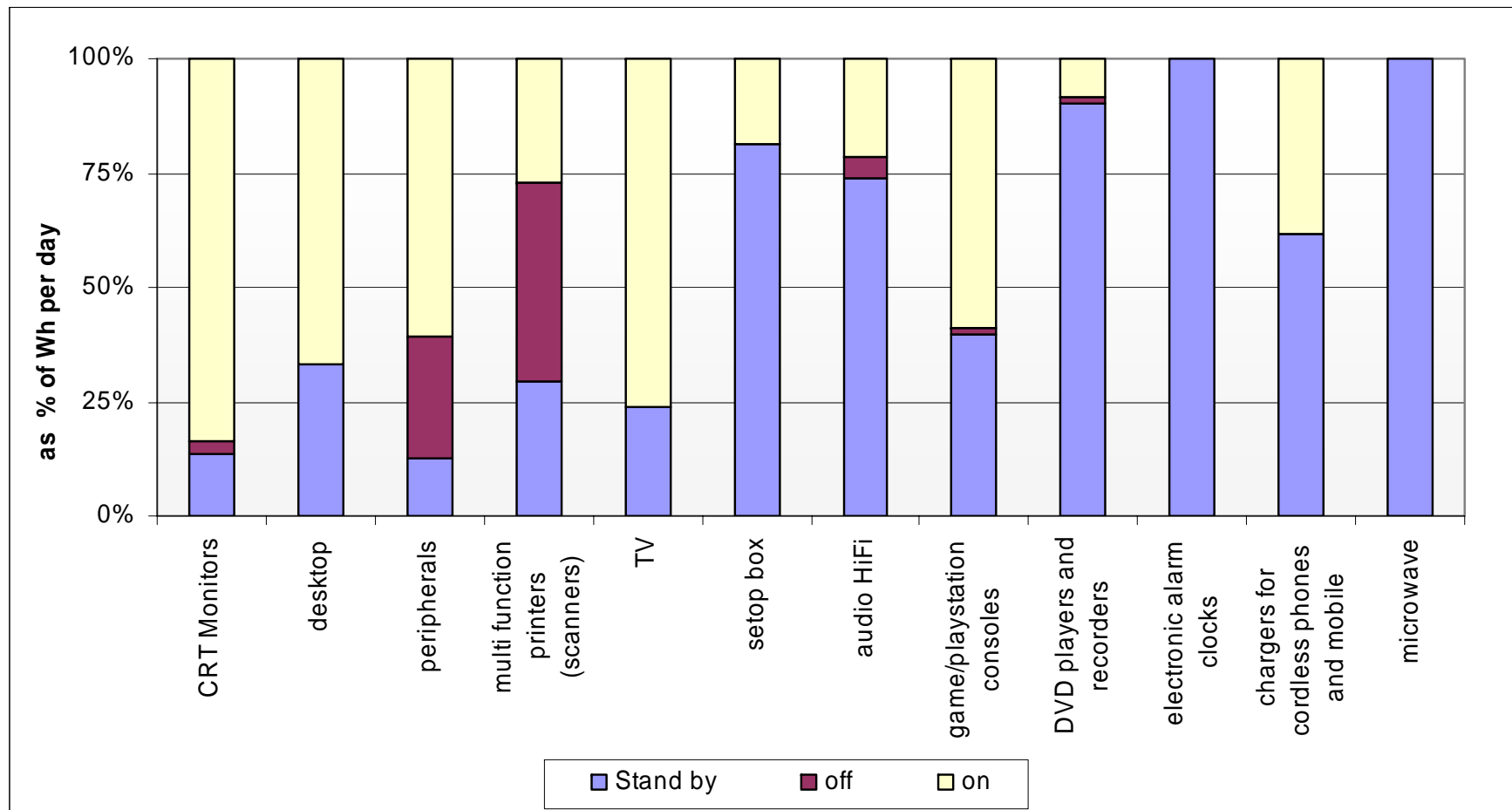
# Power consumption of Laptops



# Average power of domestic entertainment loads in the distinct operating modes



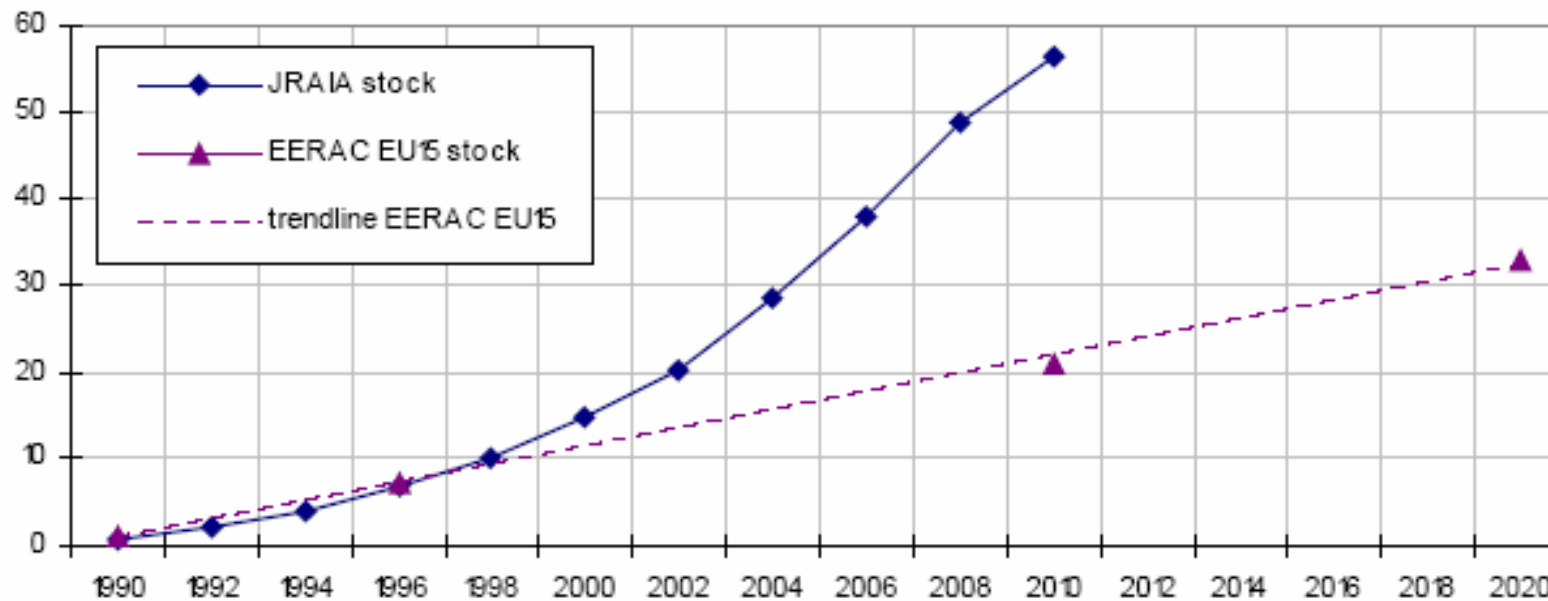
# Stand by, off and on mode electricity consumption as % of their total consumption



# Development of Room Air Conditioning Stock in EU-15



RAC stock 1990-2020 based upon EERAC and JRAIA data (mio units)





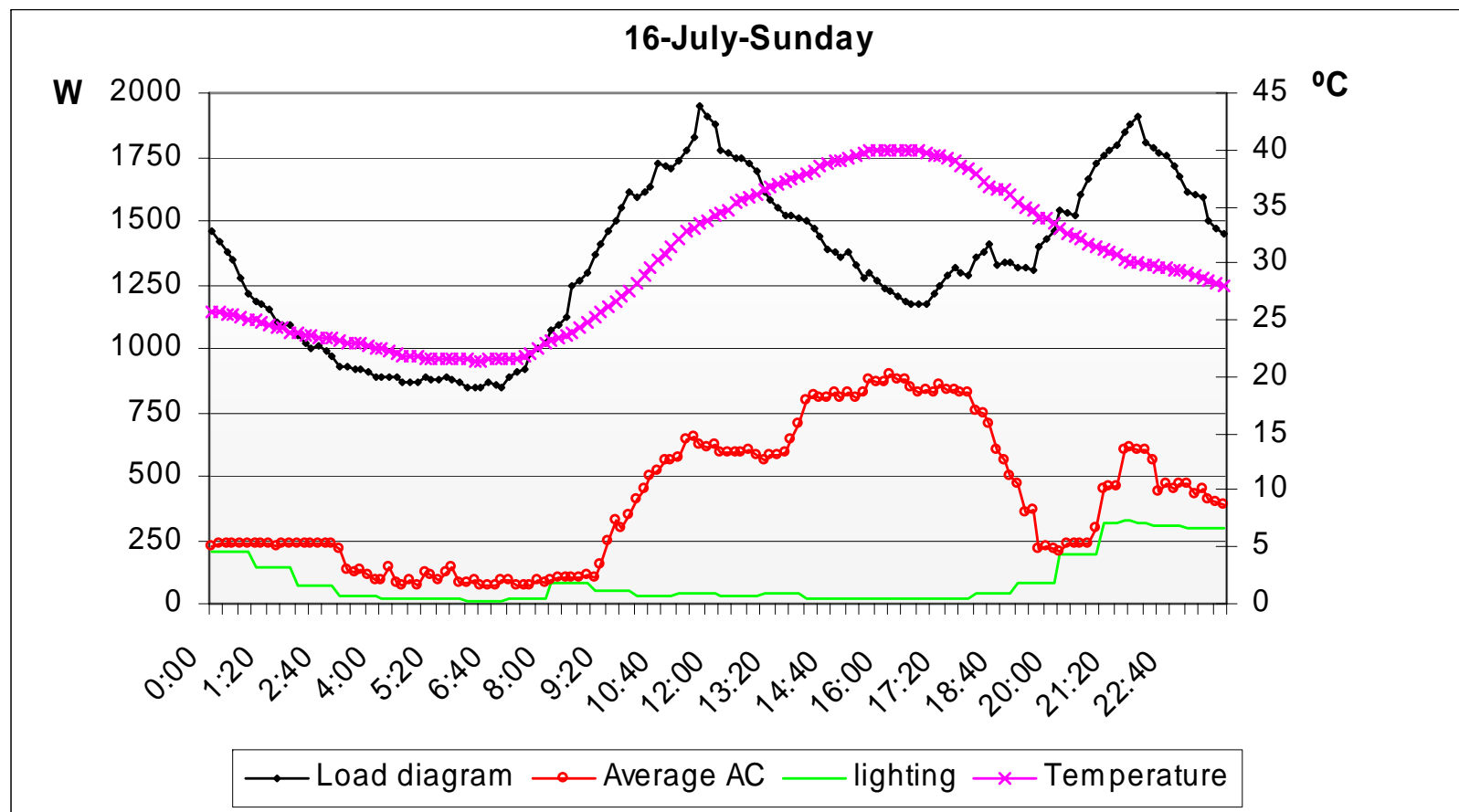
# Driving factors for air conditioning growth



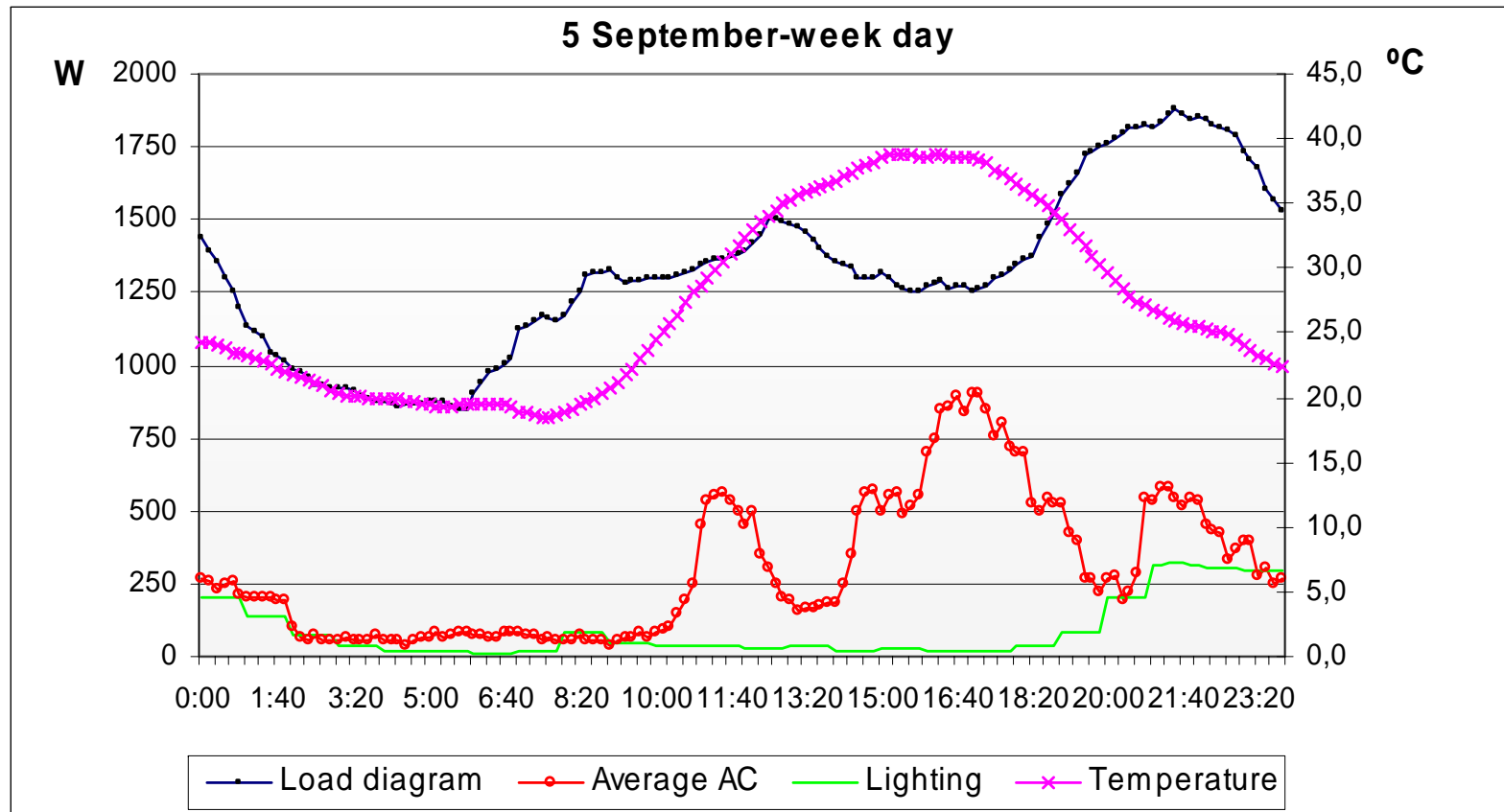
- ❖ Increasing affordability
- ❖ shifts in comfort culture, behavioural patterns and consumer expectation
- ❖ increase in internal heat loads
- ❖ general trend towards higher temperatures
- ❖ perception that comfort cooling contribute to higher productivity



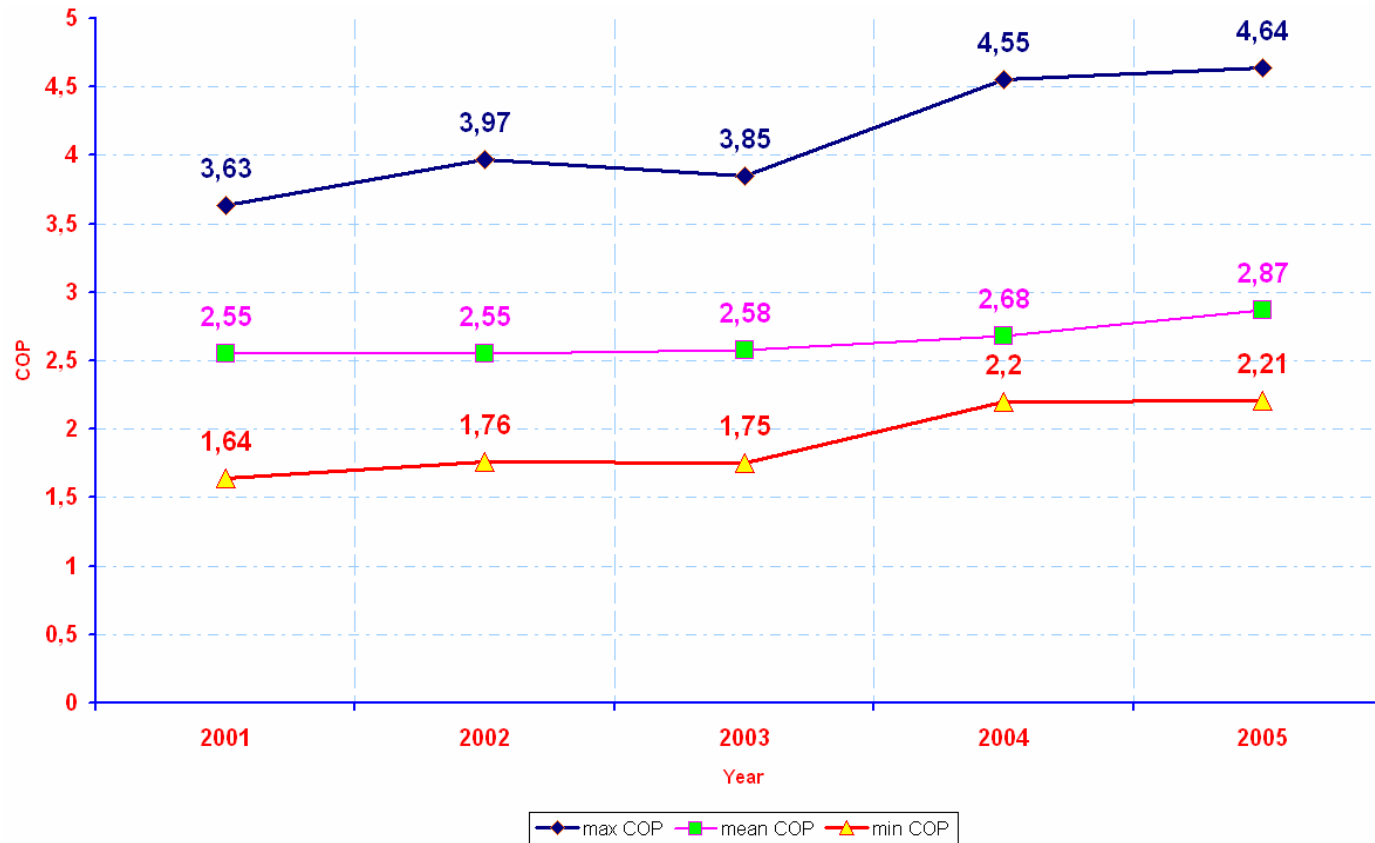
# Daily load profile of air conditioning and lighting in a weekend day



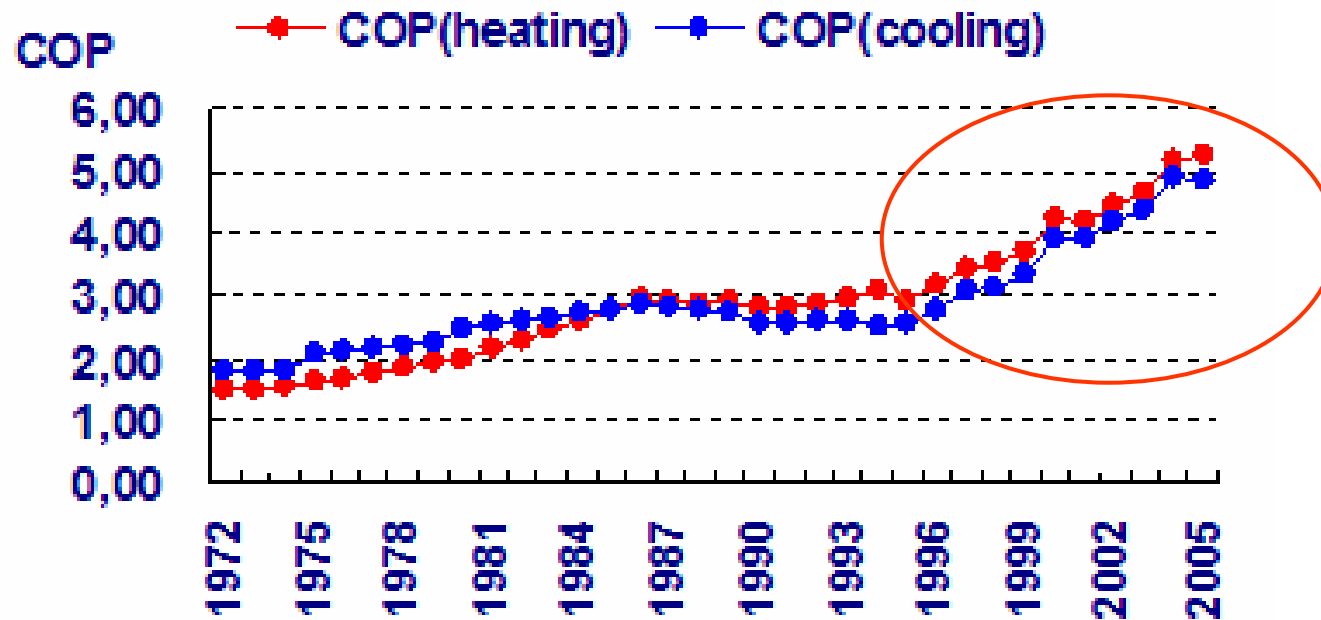
# Daily load profile of air conditioning and lighting in a working day



# Evolution of energy efficiency of split, non ducted, air-cooled air conditioners up to 12kW in the EU



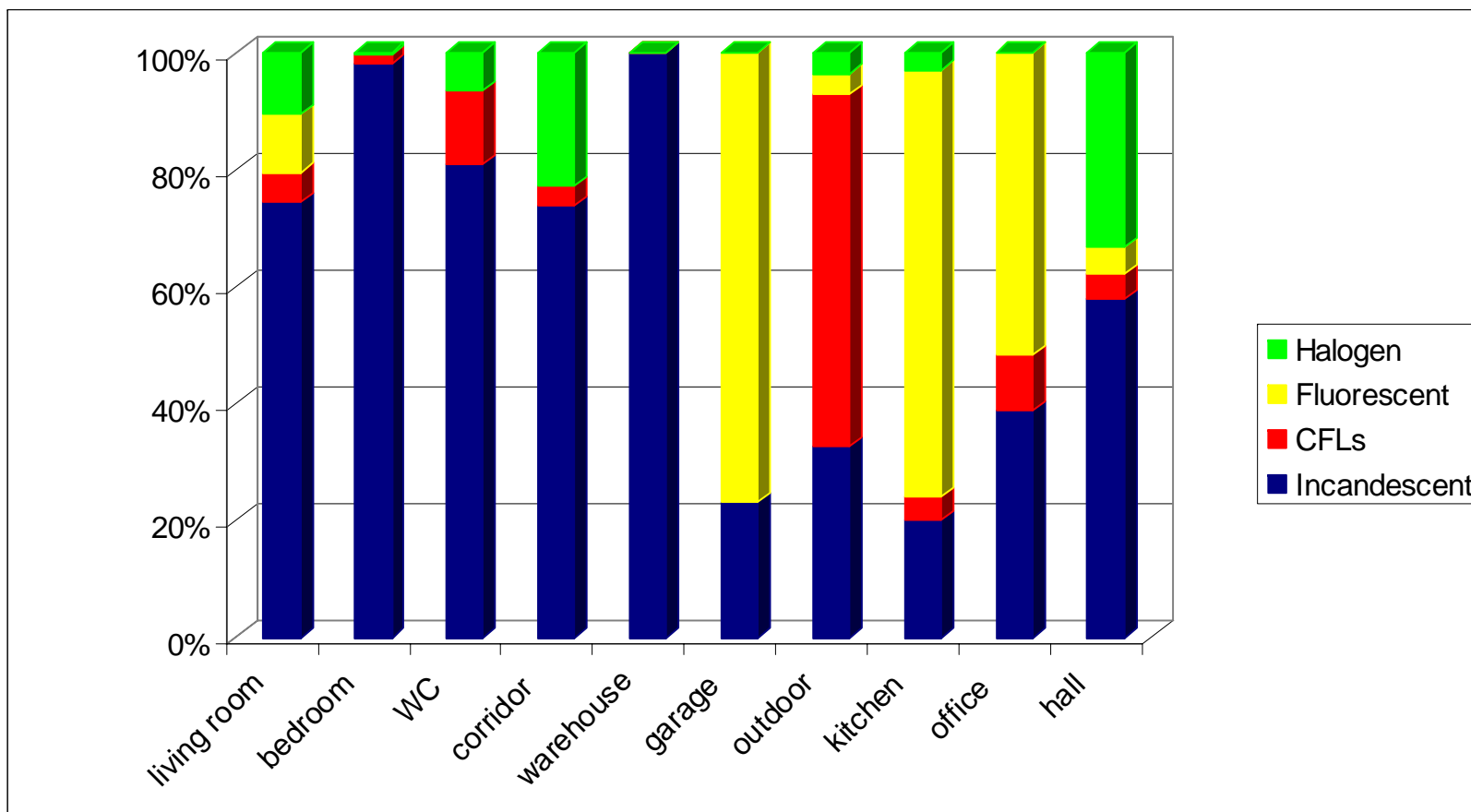
# COP of Room AC in Japan (for residential use)



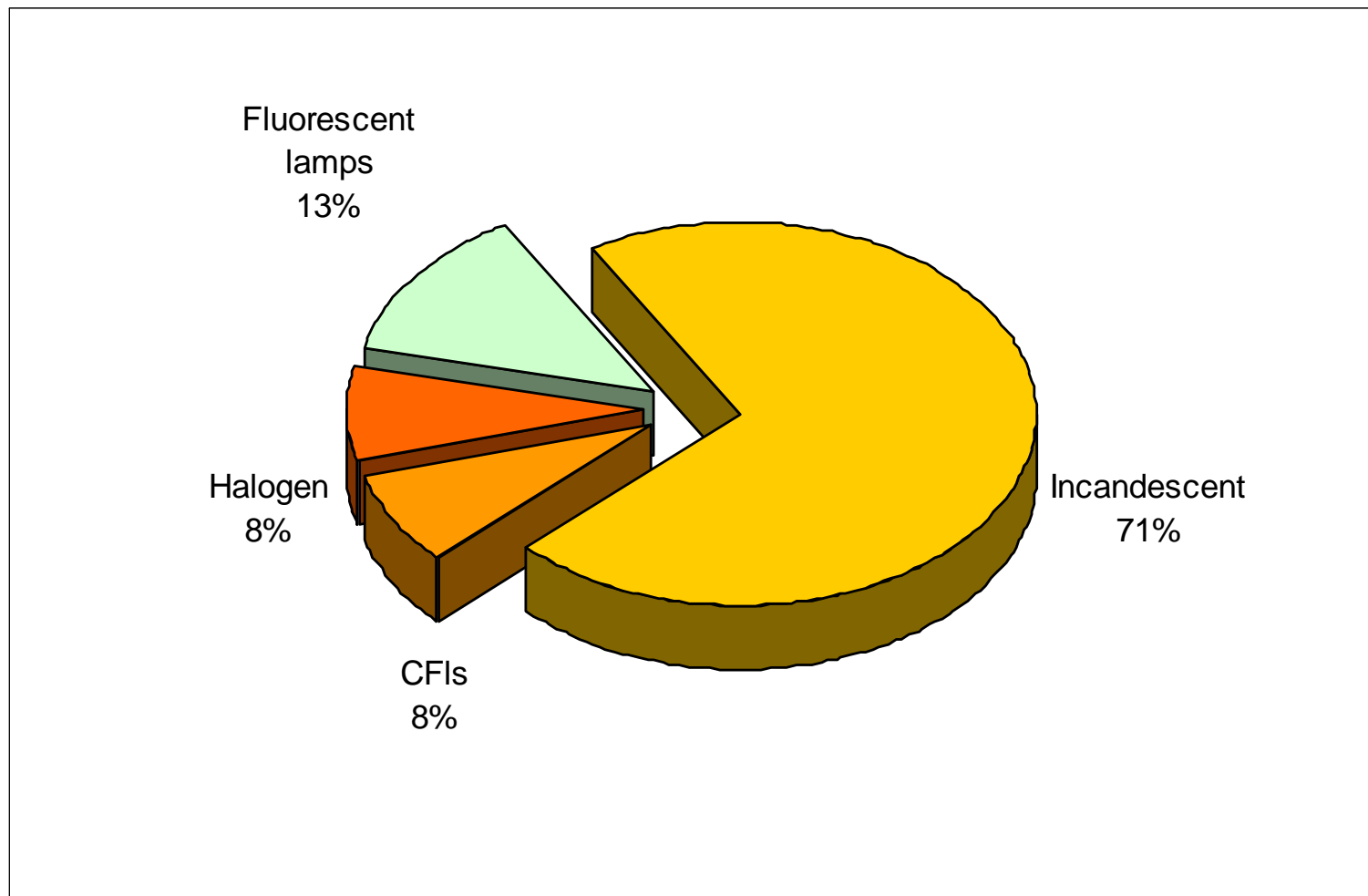
Max COP = 7



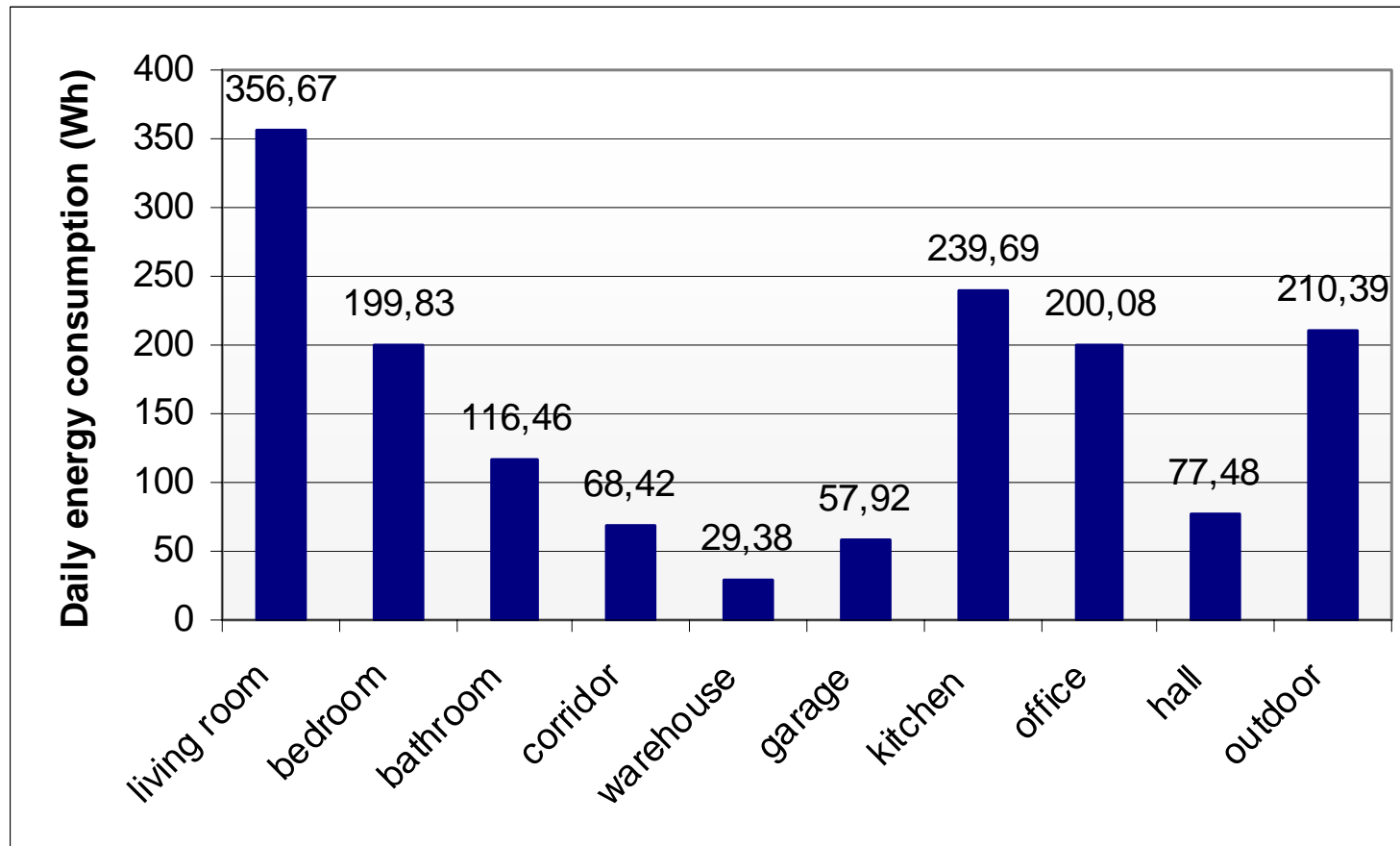
# Percentage of the type of lighting per room type



# Disaggregation of type of lighting

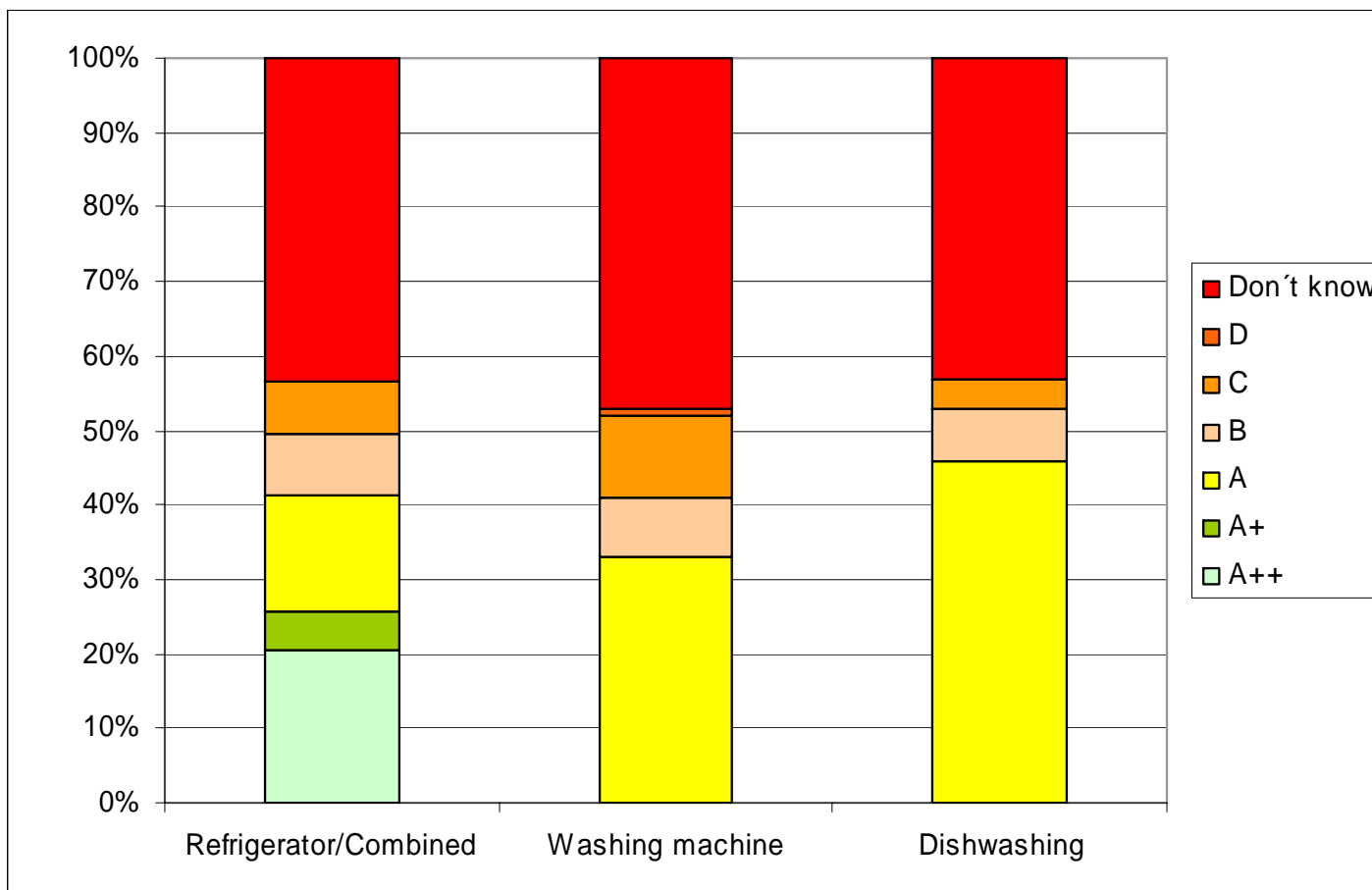


# Estimation of the daily lighting consumption per room type

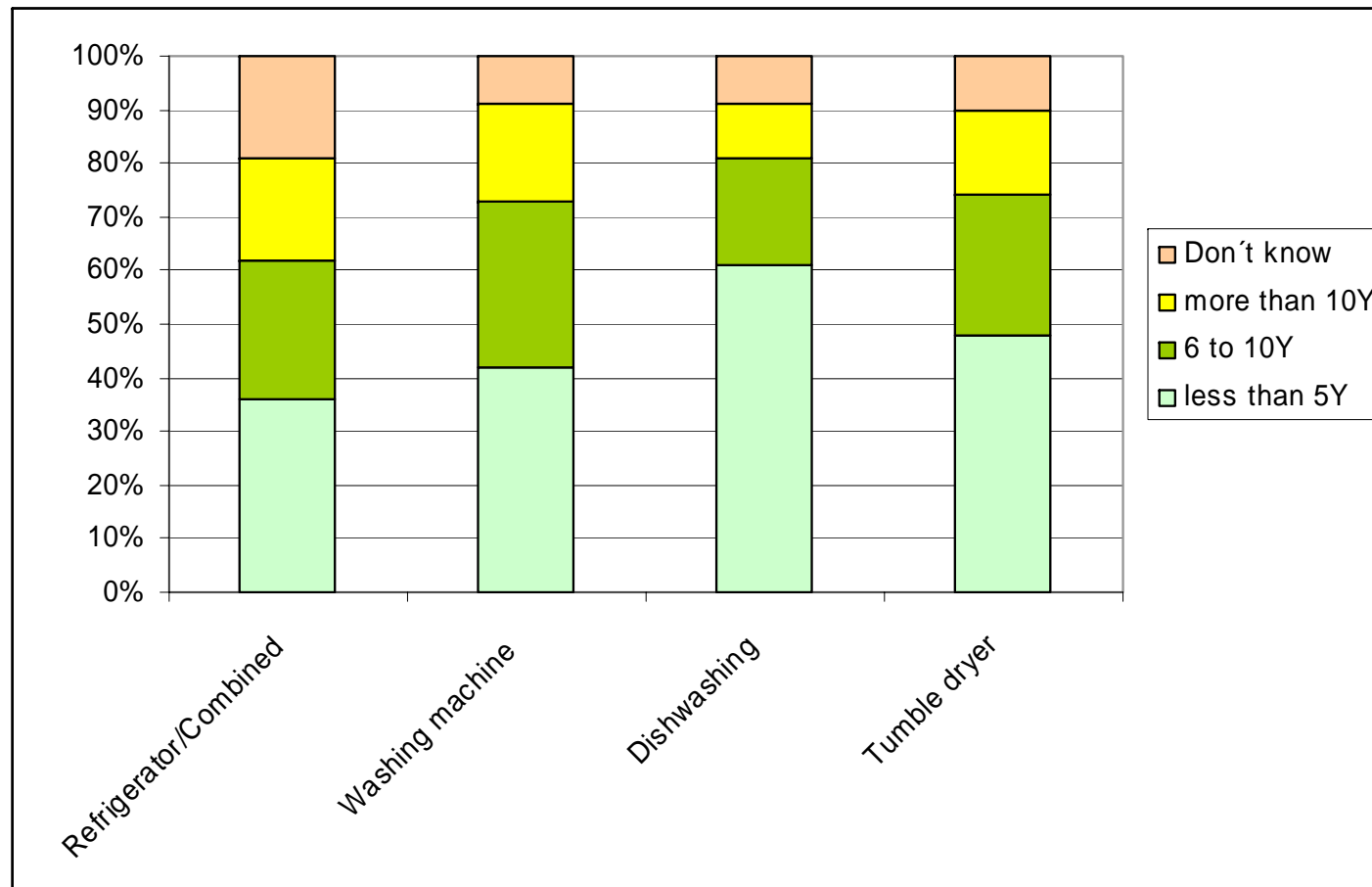




# Efficiency class of white appliances (stock)



# Age structure of appliances (stock)



## Some Conclusions



- ❖ electronic loads are key contributors to the power demand contributing up to 72% of the total energy consumption in the stand by mode
- ❖ there is a wide range of performance levels in the models available in the market
- ❖ Residential air conditioning load is increasing fast and is already a major contributor to summer peak demand in Mediterranean countries. The air conditioning market has been flooded with very low cost and very inefficient units, therefore needing urgent attention.
- ❖ the growing penetration of CFLs is reducing consumption, but on the other way the increasing penetration of halogen lighting is pushing up the lighting consumption. LEDs increasing availability may replace some spot halogen applications with significant energy savings.

