HOUSEHOLD ACTIVITIES THROUGH VARIOUS LENSES

QUESTIONNAIRE – DIARIES - MEASURED CONSUMPTION

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INTRODUCTION

- Behaviors in energy models: describe diversity + look for savings
- Beyond technical models and dedicated energy saving gestures
- Daily activities in time & power issues
- Activities and appliance usage

- Link what people do and the amount of electricity consumed
  - Multiple measurement methods: questionnaire, diaries, electric consumption measures
  - Consistency and relevance: not one world
  - Activity meaning of energy consumption

MAIN FINDINGS

- General consistency:
  - Questionnaire: diversity in the level of active use
  - Diaries: good measure of activities timing

- Meaningful discrepancies varying by appliance
  - Consistent duration for TV and computer vs. frequency for washing
  - Electricity consumption when not used significant for PC not TV

→ Activities from questionnaires and diaries are good indicators of the diversity of electricity consumption between households

→ "Time Use surveys" are relevant to analyze electricity load curves, taking into account specific implications of different activities

DATA

Collection methods and nested sample

	Households (n =)
Quantitative survey	1949
Qualitative in depth interviews	-> 60
1 week diary	-> 56
1 week real time power demand by appliance	-> 59

Appliances analysed

- TV set
- Computer (desktop)
- Washing Machine

- Many others measured

DATA

Diaries and power split into 2 seasons

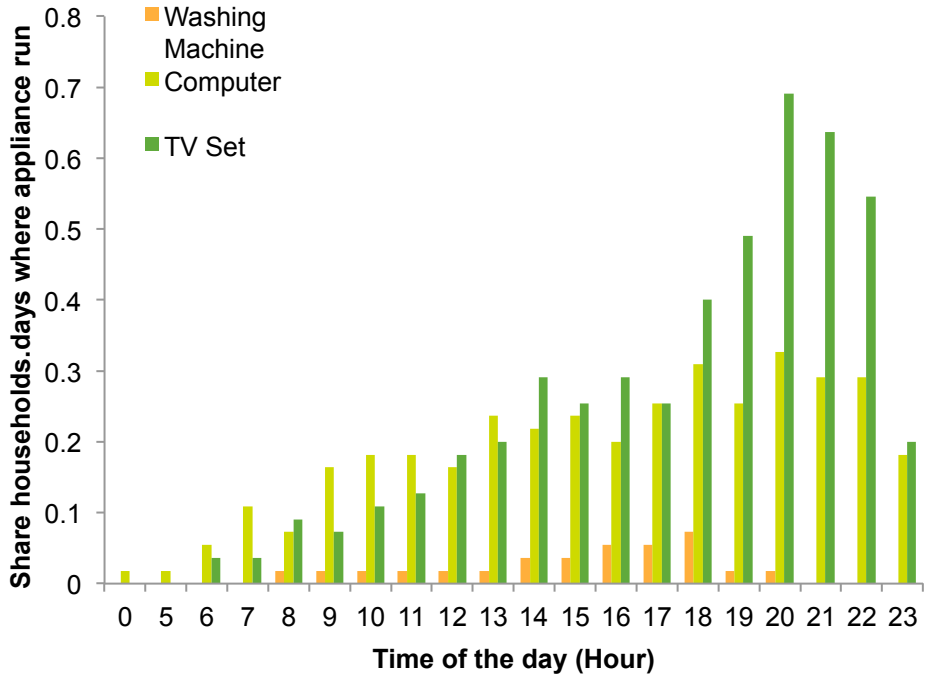
- Summer : MAY, JUNE, JULY -> 26 households
- Winter : OCTOBER, NOV, DEC, JANUARY -> 34 households

Measurement levels differ in several ways

	Survey	Diary	Sensors
Time scale	"Overall"	1 week	1 week
Unit	hours of activity/day activity freq /week	main activity /mn	Wh/mn
Type	General perception	recent memory	objective

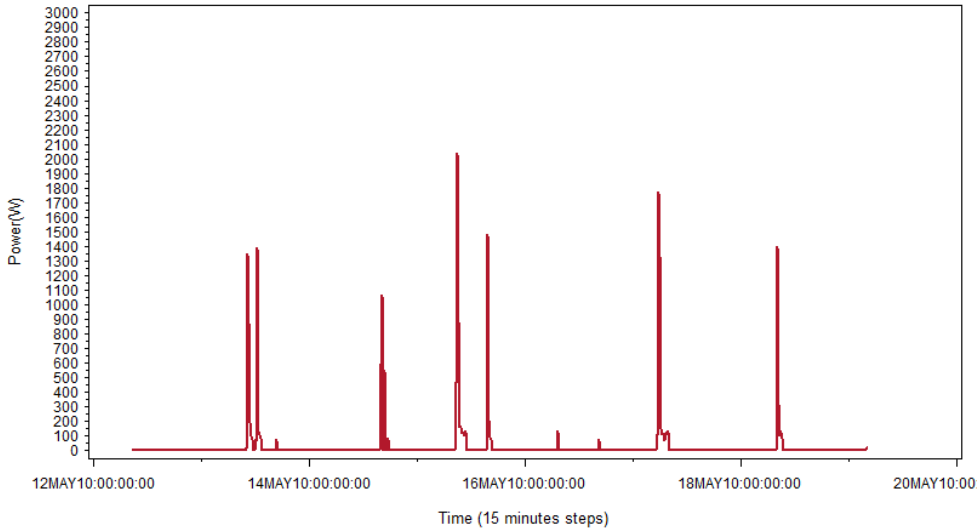
DIARIES

- People were asked to state the appliances used for every activity



Average % of use by hour of the day for the three appliances studied (averaged over households and days)

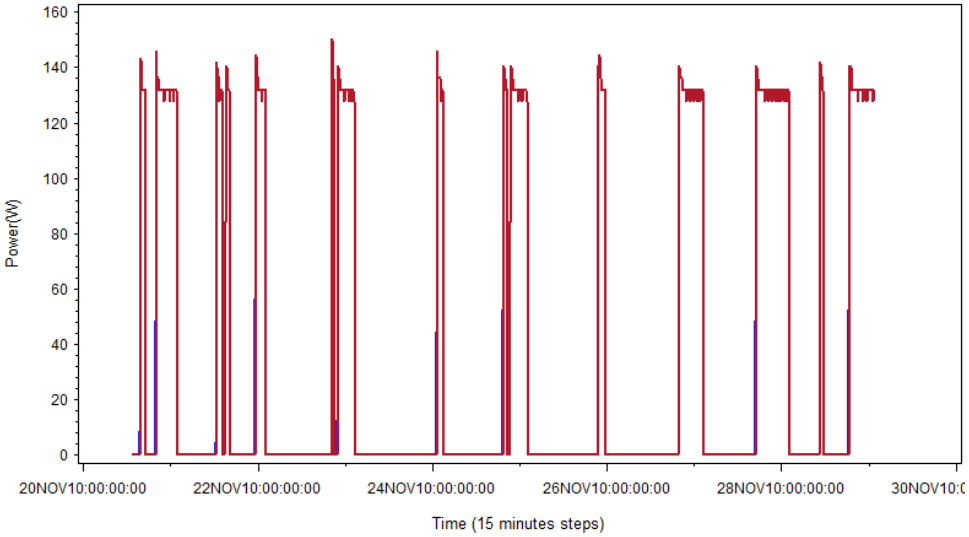
ELECTRICITY MEASURES

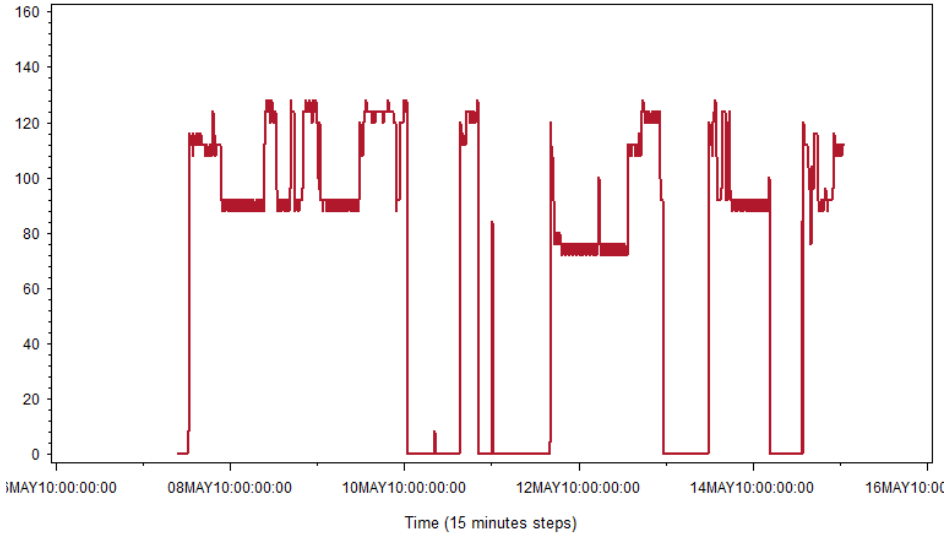


Washing Machine

TV

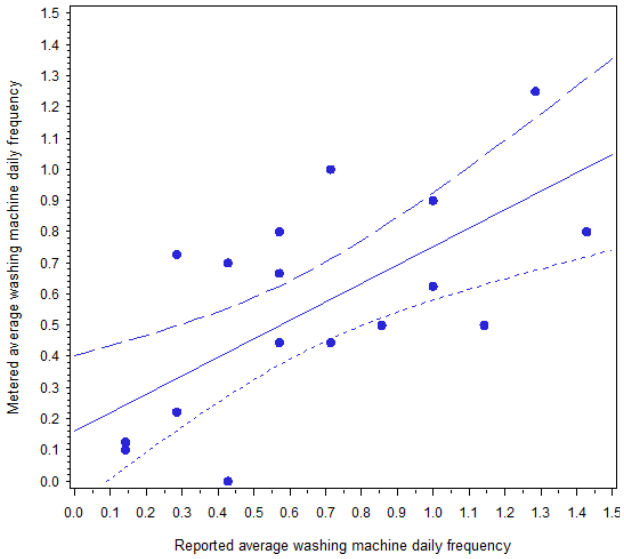
Computer



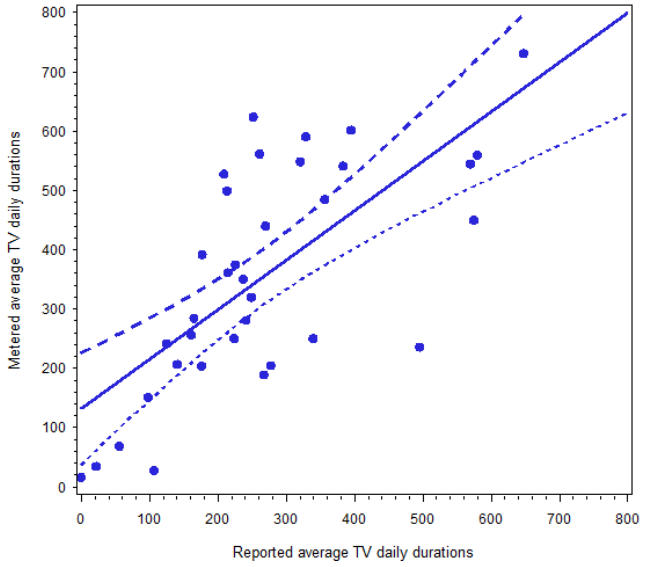


RESULTS – INTENSITY OF USE

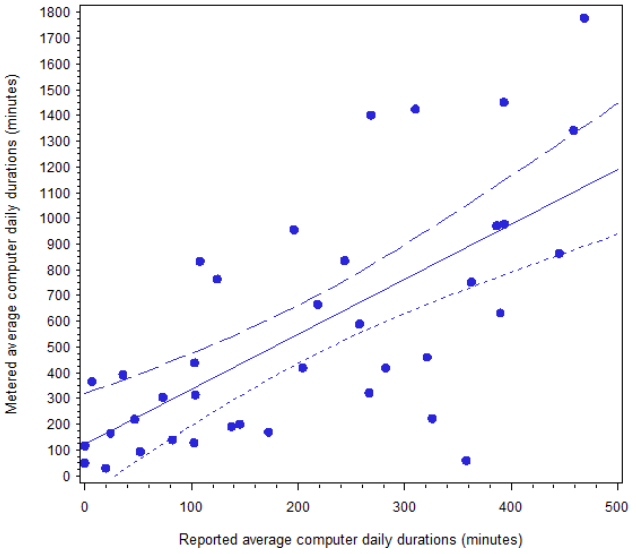
- Diary vs. measured consumption:



Washing frequency



TV duration



Computer duration

RESULTS – INTENSITY OF USE

- Diary vs. measured consumption:

	n obs.	Mean (meter)	Mean (diary)	Mean difference[1]	Pearson correlation
Number of uses / day					
Washing Machine	19	0.53	0.37	0.16	0.69**
Computer	38	2.09	2.33	0.29***	0.43**
TV Set	38	1.46	3.12	1.66**	0.47***
Total duration / day (minutes)					
Washing Machine	18	49	22	27**	0.68**
Computer	38	566	208	358	0.68***
TV Set	38	361	292	132**	0.79***

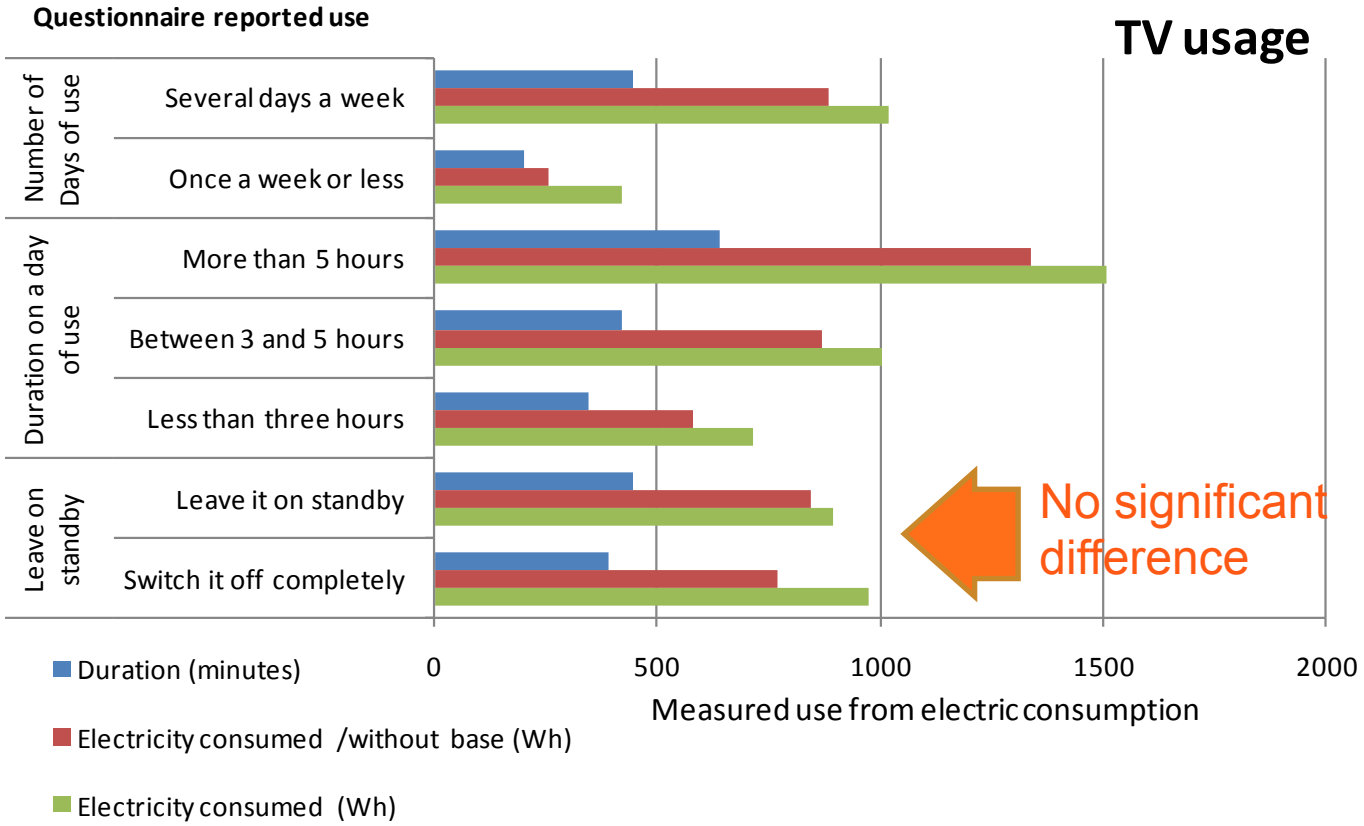
[1]mean(meter)-mean(diary)

Significance of the difference to 0: *** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05

- Absolute levels do not agree: more fragmented perceived leisure
- Correlations are very significant discriminating households in the same way

RESULTS – INTENSITY OF USE

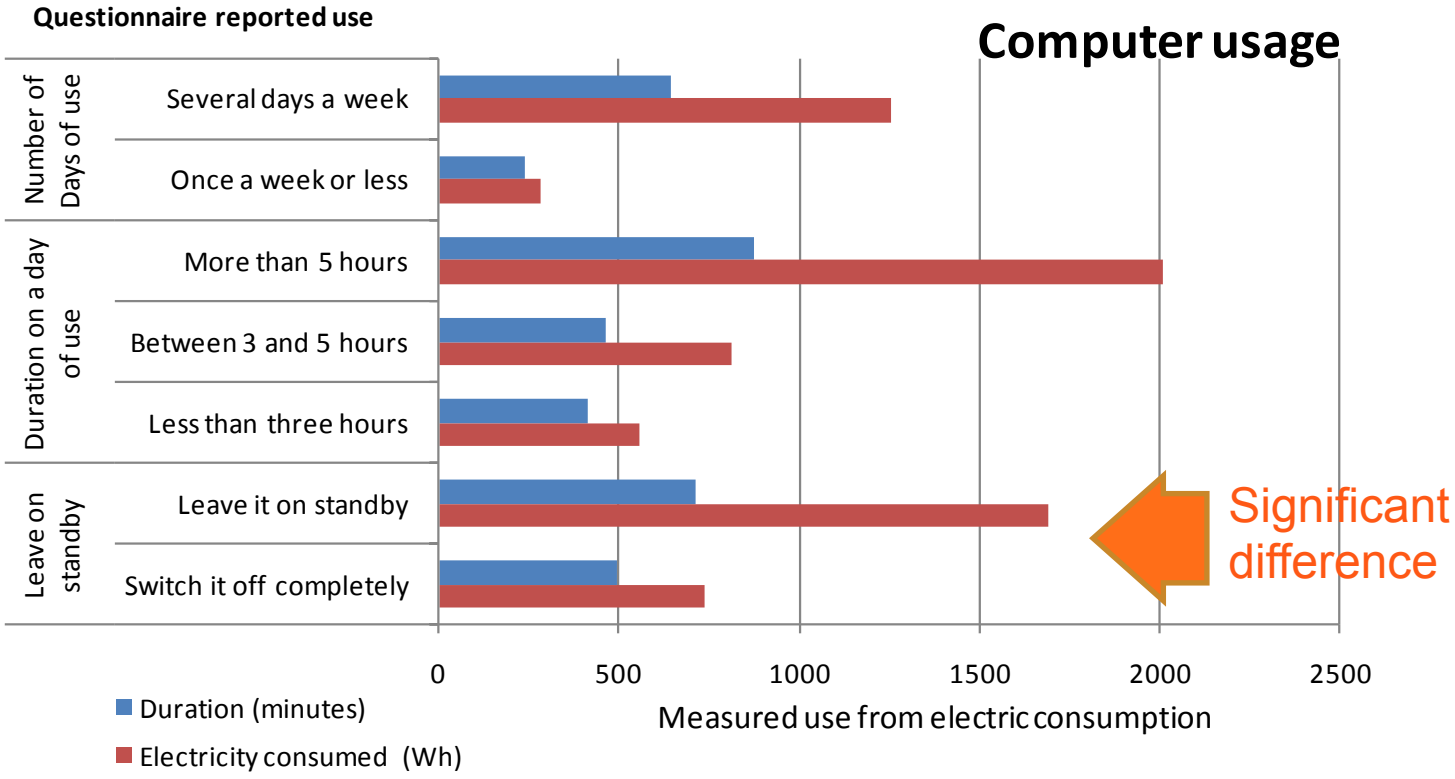
- Questionnaire vs. measured consumption:



- Reported Intensity of use explains consumption for TV and PC

RESULTS – INTENSITY OF USE

- Questionnaire vs. measured consumption:



- Switching off when not used matters for PC not TV

RESULTS – SAVINGS AND APPLIANCES

- Questionnaire vs. measured consumption:

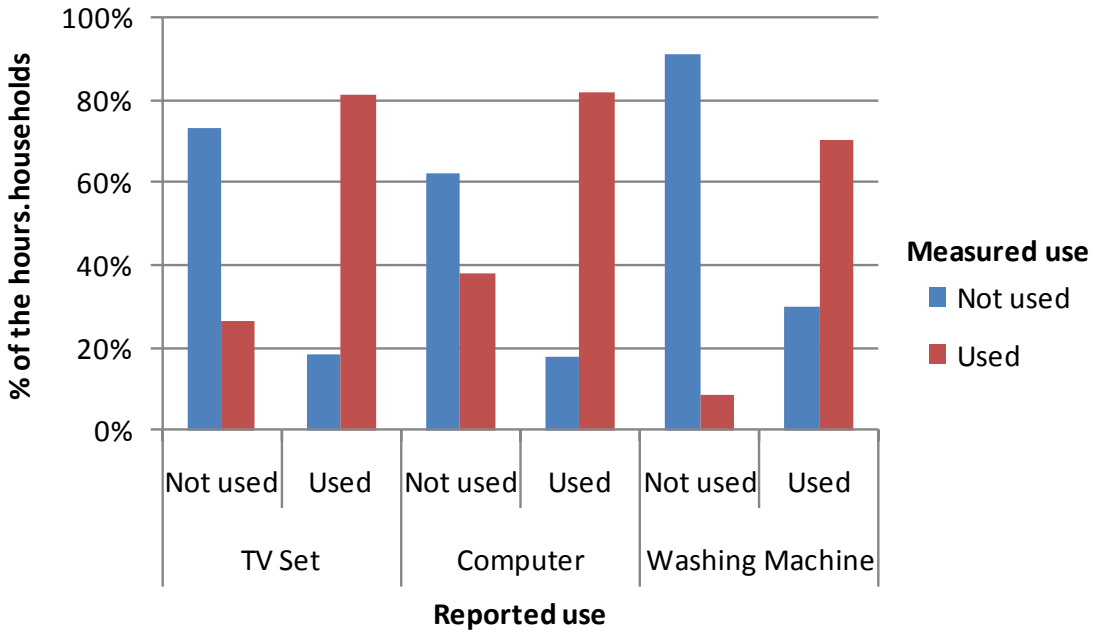
			TV Set				Computer				Washing Machine		
	Measured average daily usage by appliance		Number of use	Duration (minutes)	Electricity consumed /WB[1] (Wh)	Electricity consumed (Wh)	Number of use	Duration (minutes)	Electricity consumed (Wh)		Number of use	Duration (minutes)	Electricity consumed (Wh)
Questionnaire reported usage													
ANOVA models	Factors			-Days used -Duration	-Days used -Duration			-Days used -Duration	-Duration -Stand by		-Days used		
		R2		**0.23***	**0.20***			**0.21***	**0.25***		**0.36****		
	Additional factors				+ TV Size	+TV Size +Number of TV Sets							
		R2			**0.44*****	**0.35****							

[1]WB = Energie consumption after removing the base consumption (less than 10 W or 50% of power of the TV set).

- TV size has a major impact and allows to predict 44% of the actual consumption when associated to reported duration of use
- Washing machine frequency is well reported but don't explain consumption

RESULTS – TIME OF USE

- Diary x Measure confusion table



Comparison of the measured and reported working state for each hours of the week

- Computers working while not used more often (38%)
- Washing machine not working while used more often (30%): preparation, loading, delayed launch

DISCUSSION

- Overall consistency across measurement levels
- Specific patterns by activity or appliances
- Use intensity, saving gestures, and appliances can explain energy consumption (not always)

Going further

- Improved sample : larger, better account of seasons, other populations
- More activities and appliances
- Some of the factors would have needed better collection

- Link with other information: demographics, interviews
- Rich structured information: still not describing the same world as purely qualitative approaches