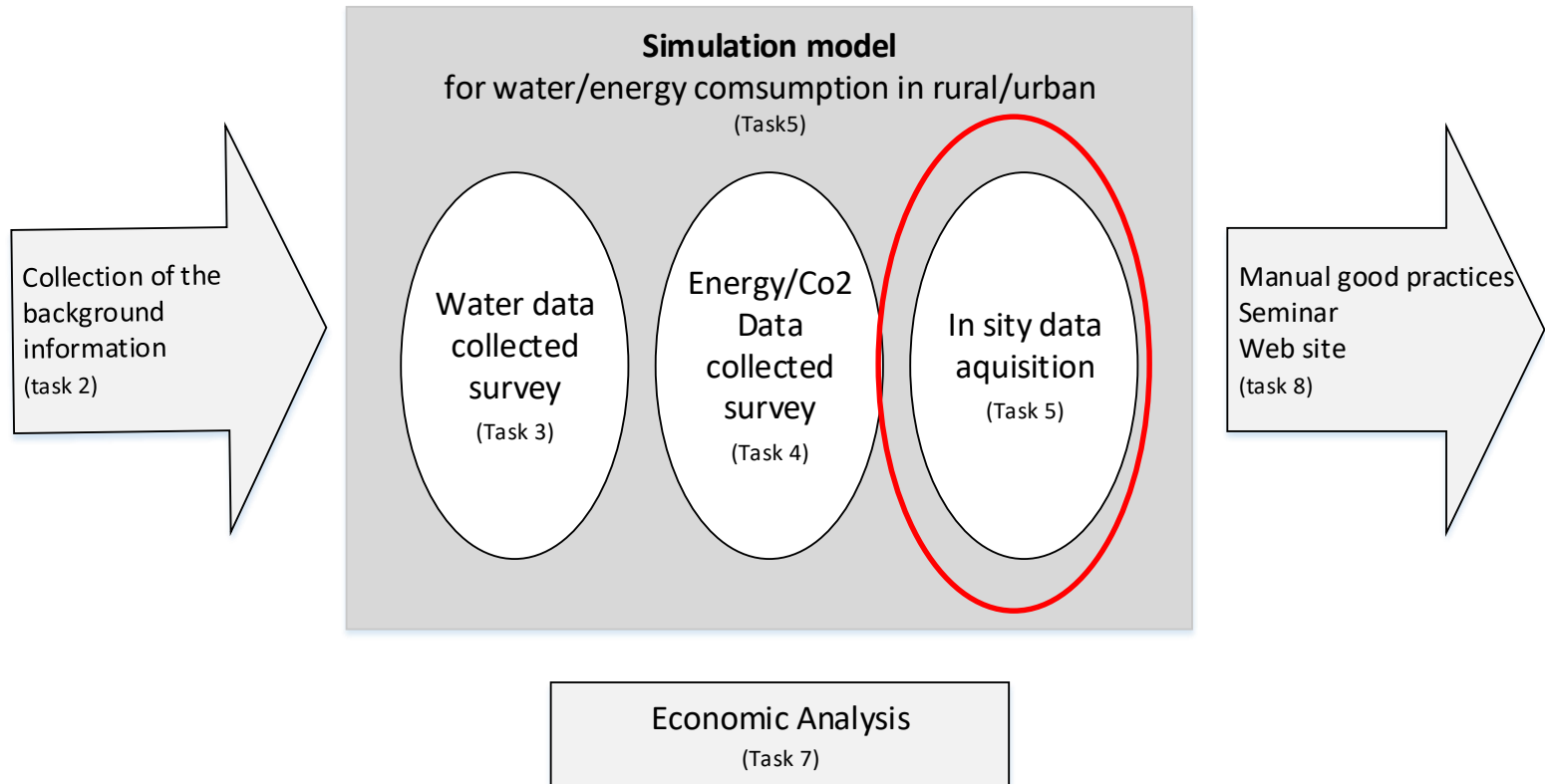# Water / Energy consumption analysis

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Summary

- Introduction

- Methodology

- Results and Discussion

- Final Remarks

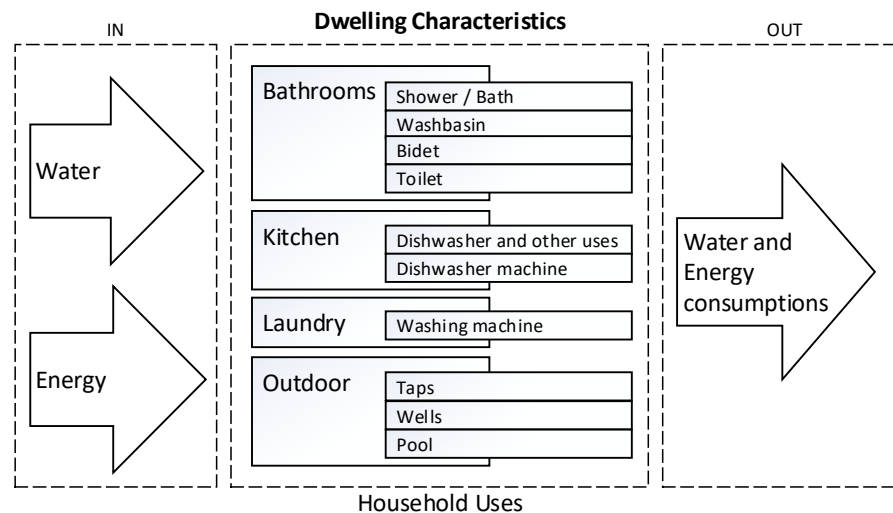- Work in progress

- We hope to find…

Simulation model
for water/energy comsumption in rural/urban
(Task5)

Collection of the background information
(task 2)

Water data collected survey
(Task 3)

Energy/Co2 Data collected survey
(Task 4)

In sity data aquisition
(Task 5)

Manual good practices
Seminar
Web site
(task 8)

Economic Analysis
(Task 7)

- This stage includes in situ measurements of **9 different households** (**4** in **rural** and **5** in **urban** environments) during one year;

Methodology

Case study

- It will only be presented the results of **water and energy consumptions** acquired during **one week** as an example of the data that can be obtained through the instrumentation and monitoring of the different devices in a household;

- A dwelling located in an **urban area** of Vila Real, occupied by a Portuguese standard family, where a couple lives with a teenager son;

- It has three bedrooms, two bathrooms and a kitchen;

- It is supplied by public water, electricity and natural gas;

- The water heating is ensured by natural gas;

- There is also a dishwashing machine and a laundry machine;

- A flow reducer is included in the shower device.

Methodology

Instrumentation and monitoring

- A continuous measurement of the water and energy consumptions was carried out in this dwelling following the model WATERS defined by the ENERWAT project;


Dwelling Characteristics

IN | OUT

Water

Bathrooms
- Shower / Bath
- Washbasin
- Bidet
- Toilet

Kitchen
- Dishwasher and other uses
- Dishwasher machine

Laundry
- Washing machine

Energy

Outdoor
- Taps
- Wells
- Pool

Water and Energy consumptions

Household Uses

WATERS model defined in the ENERWAT project to characterize water and energy consumptions

- A measurement period between March 27 and April 02 of 2017 (Spring season) will be presented;

Hourly and average hourly (µ) of water, electricity and gas consumptions for a week day of the measurement period
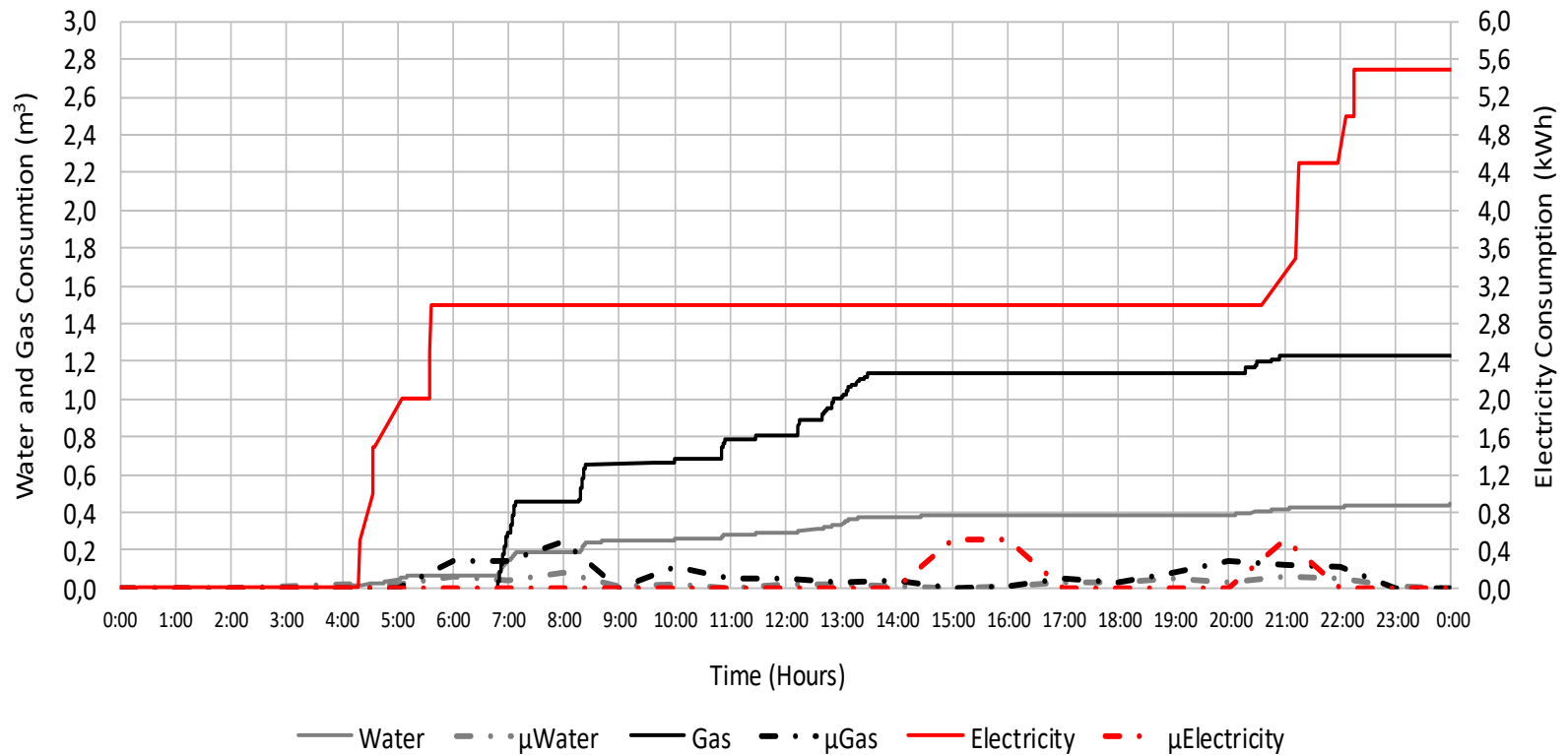
Results and Discussion

Simultaneous events for the measured week

USES	SHOWER / BATH	TOILET FLUSH	WASHBASIN	DISHWASHER	WASHING MACHINE	KITCHEN SINK	TOTAL
SHOWER / BATH		15	0	4	1	2	22
TOILET FLUSH	15		7	4	5	3	19
WASHBASIN	0	7		1	5	0	6
DISHWASHER	4	4	1		1	2	3
WASHING MACHINE	1	5	5	1		2	2
KITCHEN SINK	2	3	0	2	2		0
TOTAL	22	19	6	3	2	0	52

- The higher number of simultaneous events occurs between the shower/bath and the toilet flush (15);

- Shower/bath is the most used equipment in this house (42%) for this week;

Results and Discussion

Average water consumption (l/s) for the measured week
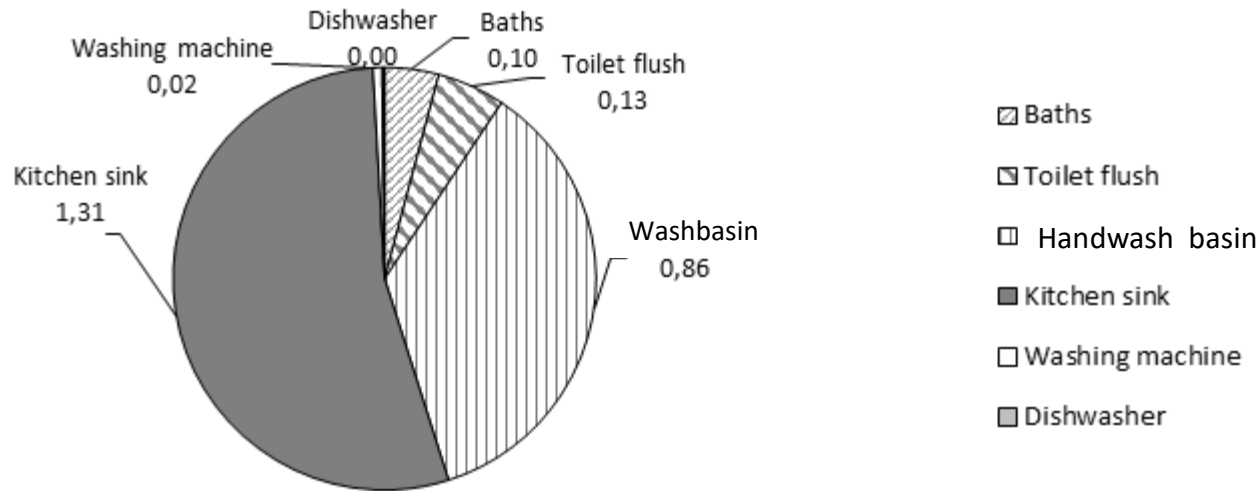
- Toilet flush consumptions were analysed and the isolated events were identified (33 isolated events occurred, corresponding to an average consumption of 0.13 l/s);

- This type of analysis allowed to determine the isolated consumptions for other events where the devices were simultaneously activated;
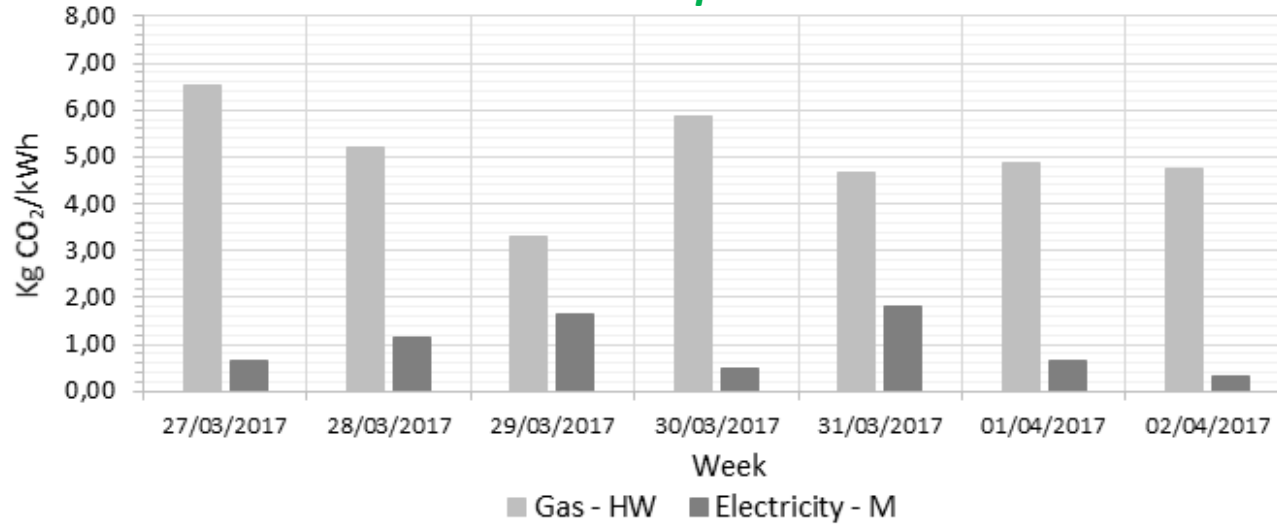
Results and Discussion

Daily consumptions of water, gas and electricity

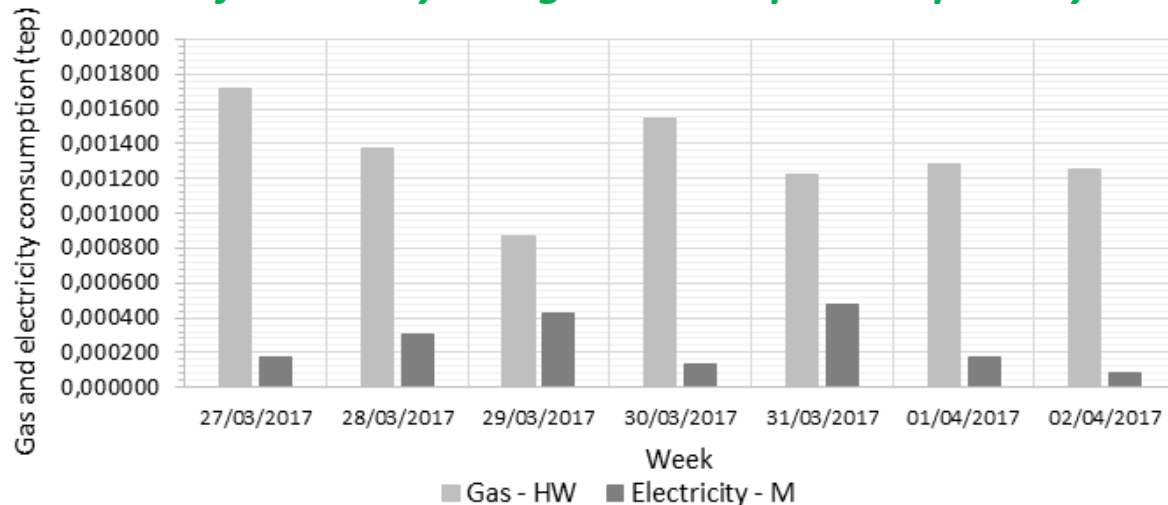| | WATER | | | ENERGY | | | | | |
| | T | HW | MW | GAS - HW | | | ELECTRICITY - M | | |
DATE	l	l	l	kWh	kg CO_2/kWh	tep	kWh	kg CO_2/kWh	tep
27/03/2017	629,00	340,15	131,98	19,95	6,52	0,001716	2,00	0,65	0,000172
28/03/2017	465,00	356,91	76,30	15,95	5,21	0,001371	3,50	1,14	0,000301
29/03/2017	550,50	220,78	197,95	10,14	3,32	0,000872	5,00	1,64	0,000430
30/03/2017	495,00	403,52	55,00	17,92	5,86	0,001541	1,50	0,49	0,000129
31/03/2017	444,00	368,10	75,90	14,21	4,65	0,001222	5,50	1,80	0,000473
01/04/2017	438,00	326,42	20,00	14,92	4,88	0,001283	2,00	0,65	0,000172
02/04/2017	441,50	324,80	50,51	14,57	4,76	0,001253	1,00	0,33	0,000086
Total	3463,00	2340,68	607,65	107,65	35,20	0,009258	20,50	6,70	0,001763
Average	494,71	334,38	86,81	15,38	5,03	0,001323	2,93	0,96	0,000252
Standard Deviation	71,47	57,03	59,74	3,09	1,01	0,000266	1,77	0,58	0,000152

Where: T- Total consumption per day; HW- Hot water consumption per day; MW- Machines water consumption; GAS–HW: Gas consumption associated with the consumption of hot water; ELECTRICITY – M: Electricity consumption associated with washing machine and dishwasher.

Results and Discussion

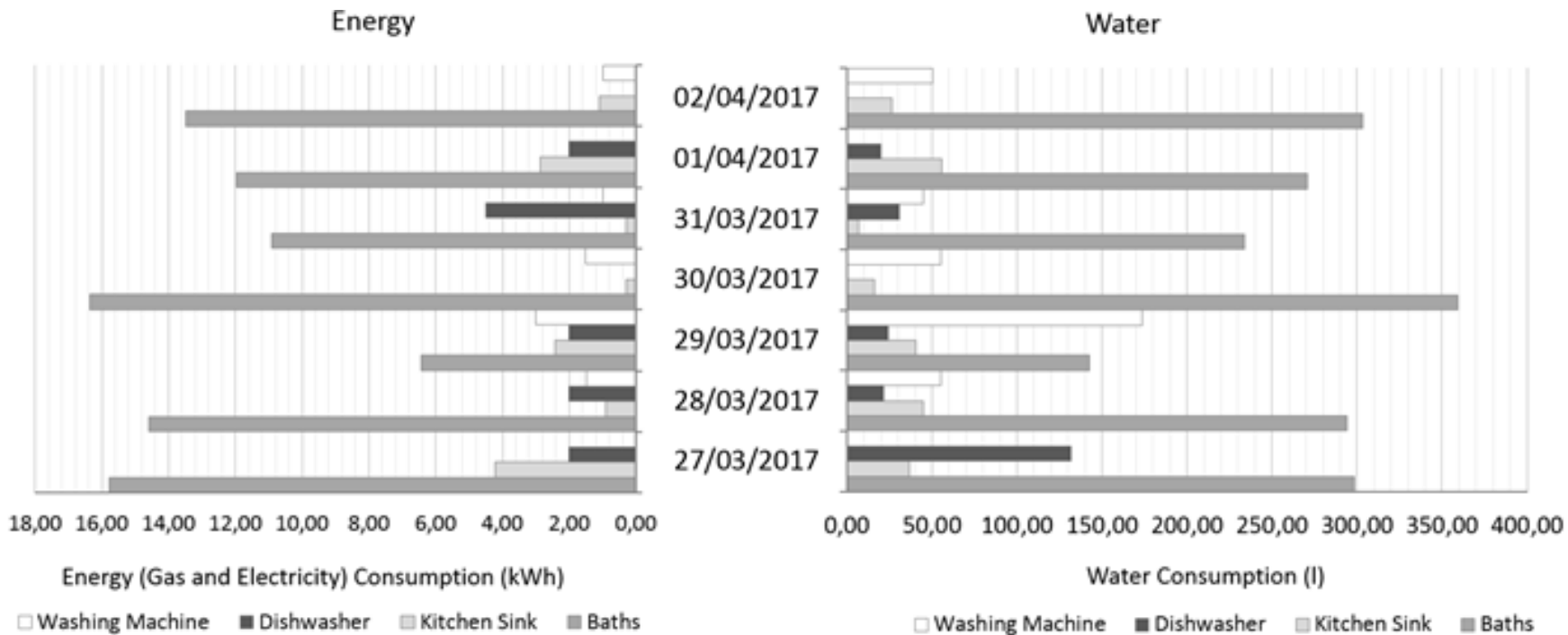***CO2 emissions caused by gas and electricity consumption linked to water consumption***

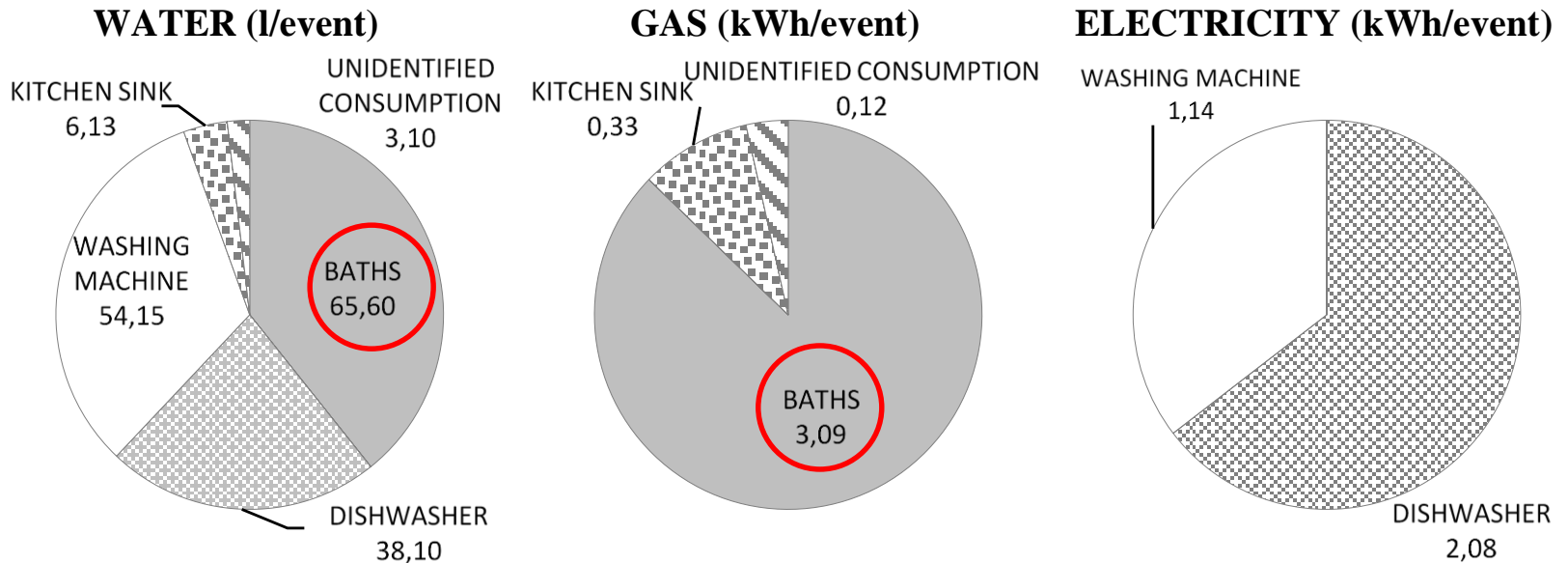***Conversion of electricity and gas consumption in primary energy***

Total daily water and energy (gas and electricity) consumptions per device

- The higher values of water and energy consumption correspond to baths.

Results and Discussion

Water, gas and electricity average consumption/device/event

WATER (l/event)

KITCHEN SINK 6,13
UNIDENTIFIED CONSUMPTION 3,10
WASHING MACHINE 54,15
BATHS 65,60
DISHWASHER 38,10

GAS (kWh/event)

KITCHEN SINK 0,33
UNIDENTIFIED CONSUMPTION 0,12
BATHS 3,09

ELECTRICITY (kWh/event)

WASHING MACHINE 1,14
DISHWASHER 2,08

- The higher values of water and energy consumption per event correspond to baths;

- Dishwasher consumes less water but more electricity when compared to the washing machine.

Results and Discussion

Average duration (min) of each device per event

KITCHEN SINK 0,89
BATHS 9,69
TOILET FLUSH 0,70
HANDWASH BASIN 0,16
WASHING MACHINE 57,73
DISHWASHER 68,30
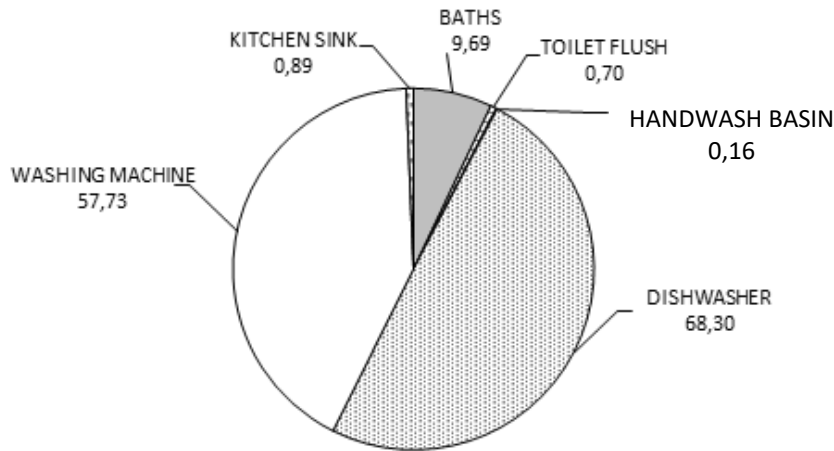
Devices use (%) per event with energy consumption (gas and electricity) related to water consumption

UNIDENTIFIED CONSUMPTION 37%
BATHS 23%
DISHWASHER 5%
WASHING MACHINE 6%
KITCHEN SINK 29%
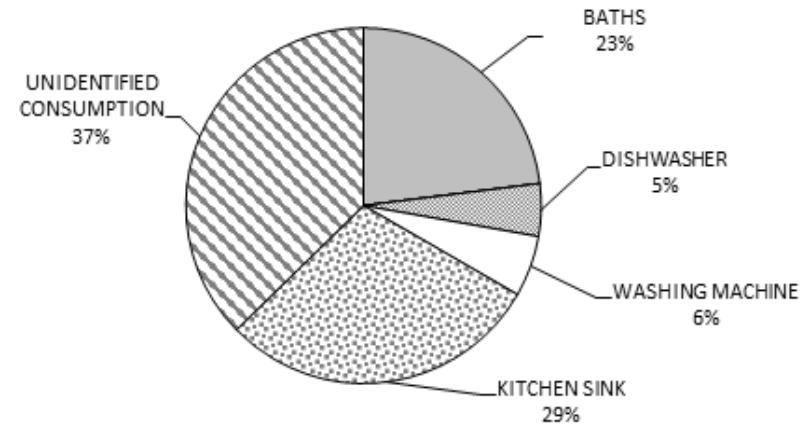
Average consumption of each device (l/s) compared with the minimum flow values established by Decree-Law no. 23/95 of August 23

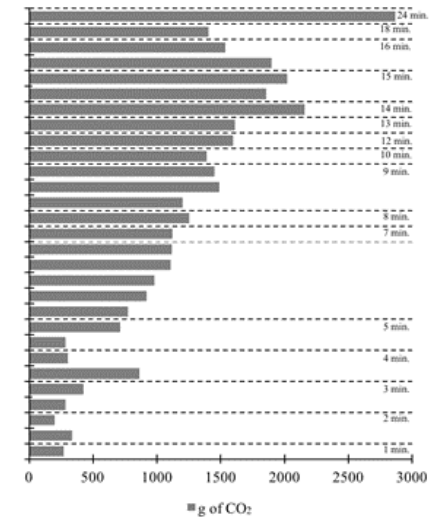| USES	AVERAGE CONSUMPTION	
	WATER	DL 23/95
	l/s	l/s
BATHS	0,11	0,15
TOILET FLUSH	0,13	0,10
HANDWASH BASIN	0,65	0,10
DISHWASHER	0,01	0,15
WASHING MACHINE	0,02	0,20
KITCHEN SINK	1,2	0,20

Water and natural gas consumptions for different showers duration
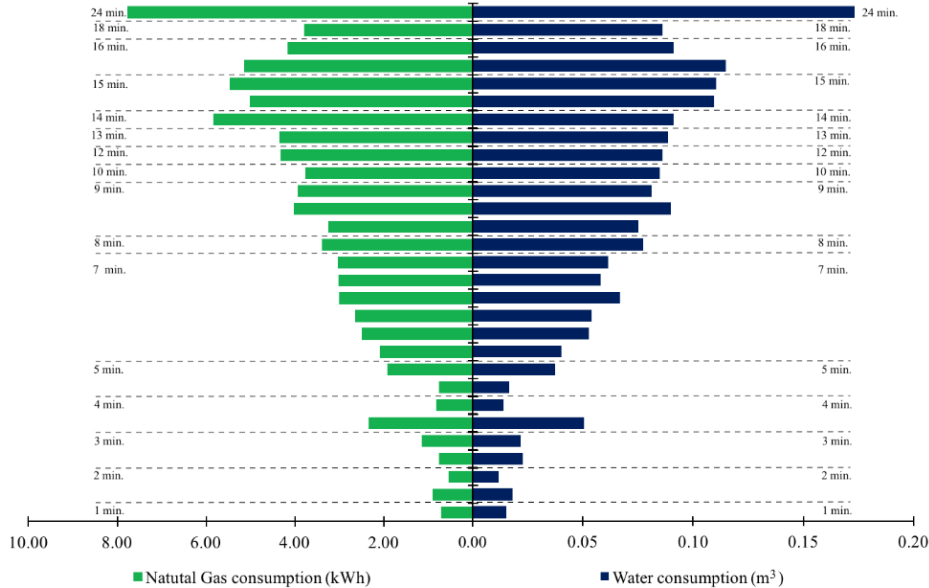
Energy consumption per m3 of water in the monitored showers

Correlation between water and natural gas consumptions

CO2 emissions for the monitored showers

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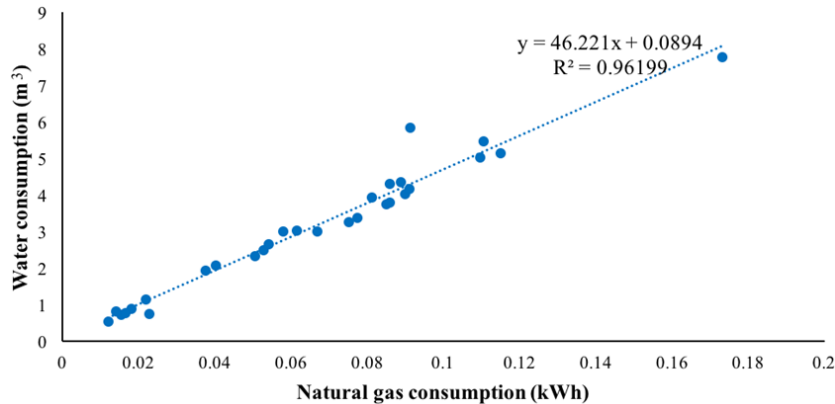
Final Remarks

- The instrumentation and monitoring of the different dwellings allow to obtain water and energy consumptions;

- It is possible to define a correlation between energy and water consumptions for different devices;

- The values obtained through *in situ* measurements are extremely important to validate the consumption simulation model;

- These results show that a continuous measurement will allow to identify consumptions patterns and user's behaviours;

- This will be extremely important to identify the influencing factors of the consumption values and define future strategies of water and energy efficiency.

Work in Progress

- Monitoring of rural and urban households, allowing to obtain water/energy consumption values for different external climatic conditions and different user´s behaviour;

- Analysis and comparison of the results obtained for different households;

- Identification of water/energy consumption patterns;

- Comparison between the results obtained through the measurements and the ones obtained by the survey;

- Definition and validation of the simulation model based on experimental values.

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We hope to find…

- Relation between energy and water consumptions;

- Water and energy consumption patterns;

- Factors influencing consumptions;

- Strategies of water and energy efficiency.

Questions

Enerwat Nexus

Obrigado!