UNIVERSIDADE DE AVEIRO

Seminar:

Water Efficiency

Aveiro. 30th May, 2012

UNCERTAINTIES AND PRACTICAL EXPERIENCIES

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EFFICIENT WATER FIXTURES

Basic Information

Indoor water uses in the residential sector		Efficient Fixtures / Actions
Taps	→	Aerators, regulators, special taps…
Shower	→	Efficient shower heads, flow restrictors …
Toilet	→	Partial and double flush,, displacement devices…
Washer / Dishwasher	→	More efficient models
Others	→	Leakage fix, change in habbits…

EFFICIENT WATER FIXTURES

Basic Information

LOW-FLOW devices

- Taps
  - Aerators
  - Flow switches
  - Flow regulators
  - Electronic taps
  - Thermostatic taps


```
Savings: up to 59%
Price:    from 200€
```

EFFICIENT WATER FIXTURES

Basic Information

LOW-FLOW devices

- Taps
- Toilets
  - Dams
  - Displacement devices
  - Fast closing valves
  - Partial flush devices
  - Double flush devices

Pulsando este botón Descarga 9 litros de Agua.
Pushing this button flushes 9 liters of water
En appuyant sur ce bouton, le déchargeoir libère 9 litres d'eau.

Pulsando este botón Descarga 3 litros de Agua.
Pushing this button flushes 3 liters of water
En appuyant sur ce bouton, le déchargeoir libère 3 litres d'eau.

Savings: 45%
Price: 25€

EFFICIENT WATER FIXTURES

Basic Information

LOW-FLOW devices

- Taps
- Inodoros
- Shower
  - Efficient showerheads
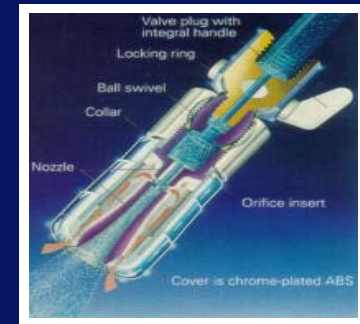 - Flow switches
  - Flow restrictors

```
Savings: 45%
Price: from 3 to 30€
```

Structure of the Program

Types of actions to take

Planning

Technical:
Aimed to improve the technology of water use fixtures

THE WATER DEMAND MANAGEMENT PROGRAM

Structure of the Program
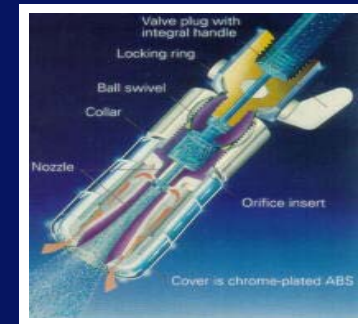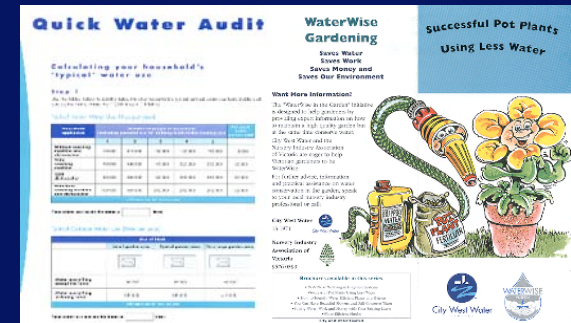
Types of
actions to take

Planning

Educative:

Aimed to modify
users' habbits

Technical:

Aimed to improve the
technology of water
use fixtures

Discouraging:

Based on changes
on the water tariff

The tariff basket formula

$$W_t = \sum_j \left(\frac{A_t(j)}{A_{t-1}(j)} \cdot t(j) \right) + \sum_j \left(\frac{B_t(j)}{B_{t-1}(j)} \cdot t(j) \right) - 1$$

THE WATER DEMAND MANAGEMENT PROGRAM

Structure of the Program

Initial conditions

Goals

Types of actions to take

Feasibility analysis
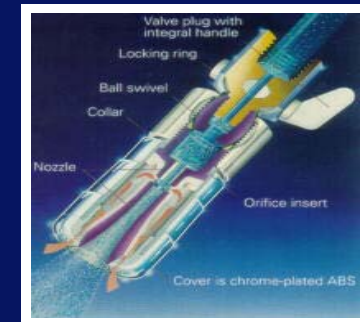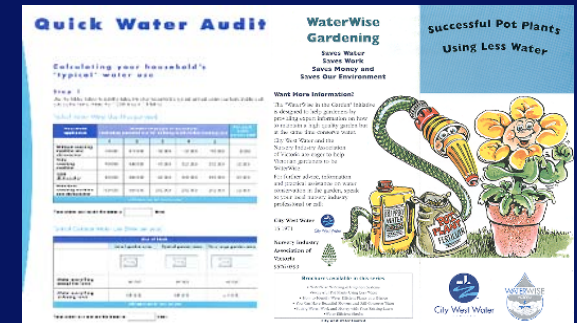
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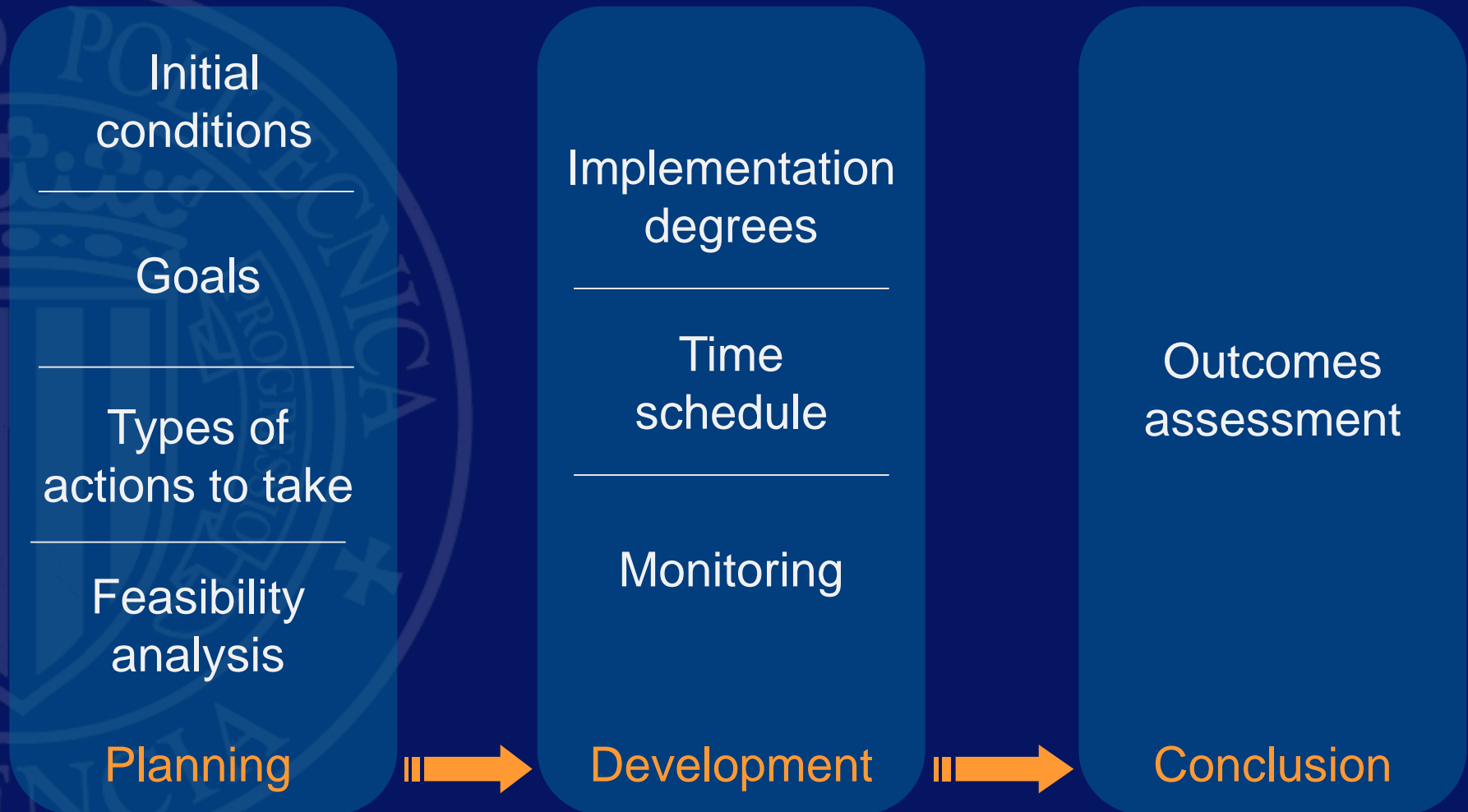
Based on changes on the water tariff

The tariff basket formula

$$W_t - \sum_j \left(\frac{A_t(j)}{A_{t-1}(j)} \cdot r(j) \right) + \sum_j \left(\frac{B_t(j)}{B_{t-1}(j)} \cdot c(j) \right) - 1$$

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THE WATER DEMAND MANAGEMENT PROGRAM

Structure of the Program

Initial conditions

Goals

Types of actions to take

Feasibility analysis

Planning

Implementation degrees

Time schedule

Monitoring

Development

Outcomes assessment

Conclusion

THE WATER DEMAND MANAGEMENT PROGRAM

Structure of the Program

Initial conditions

Goals

Types of actions to take

Feasibility analysis

Planning

But undermining an easy, straight and direct calculation of uses and efficiencies, there are important UNCERTAINTIES:

- Technical features of efficient water-use devices

- Real preassure avaliable at consumption points

- Users' habbits and response Interaction device-pressure-user

SOME IMPORTANT UNCERTAINTIES

Technical Features of Fixtures - Taps
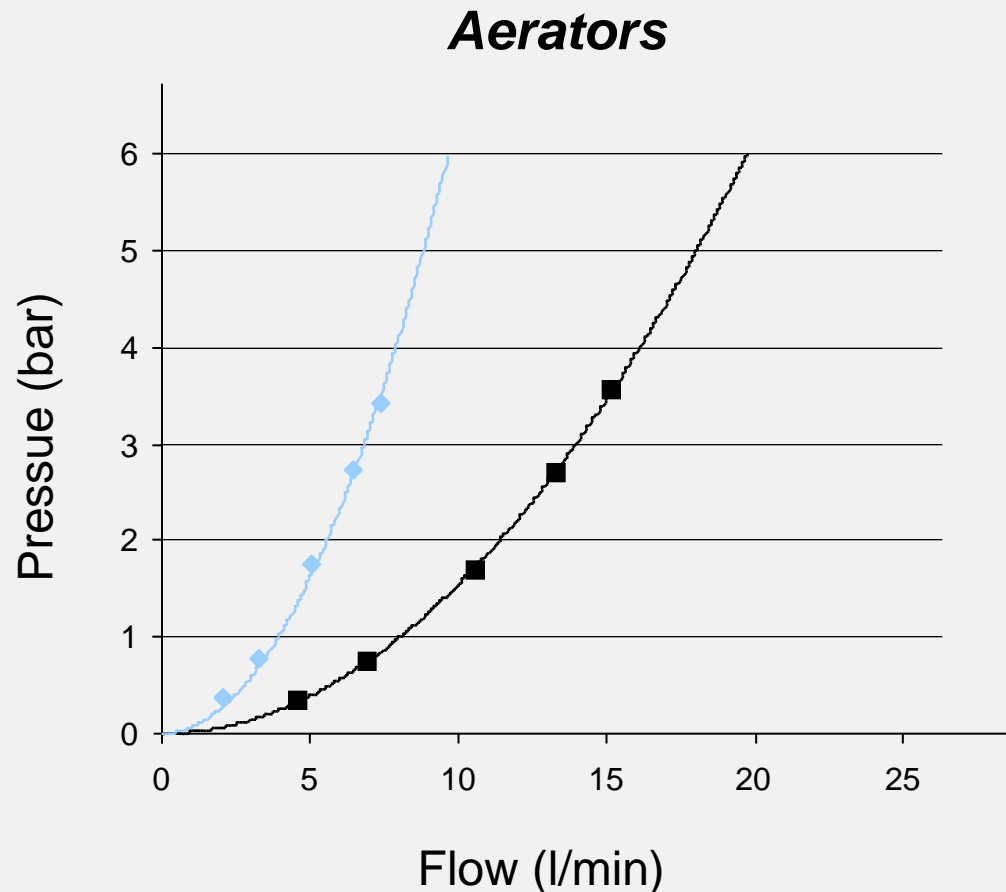
Curves obtained by performing lab tests:

$$H \text{ (bar)} = A \cdot [Q(\text{l/min})]^2$$

Standar aerator:

—■— A = 0.0153183
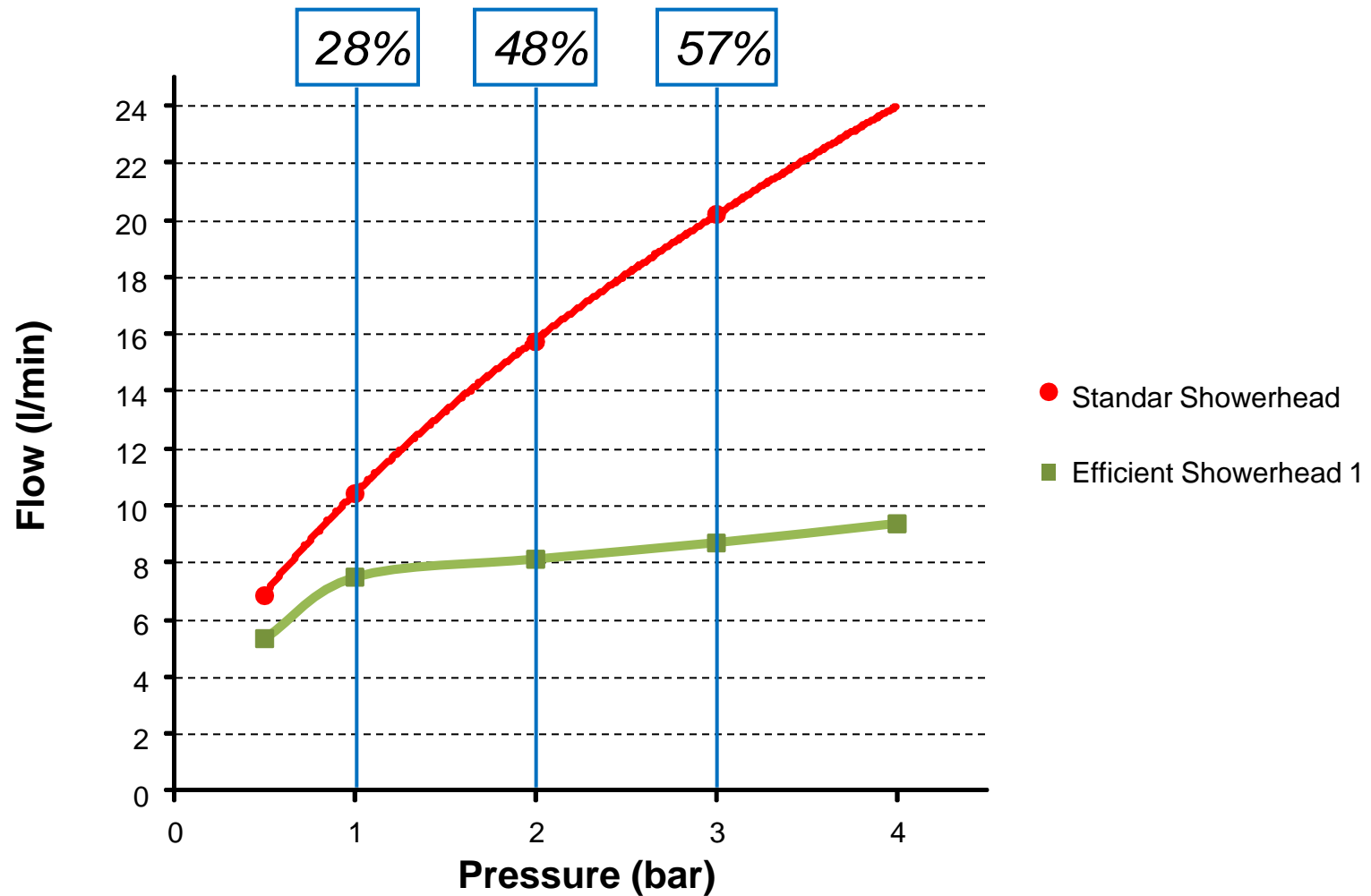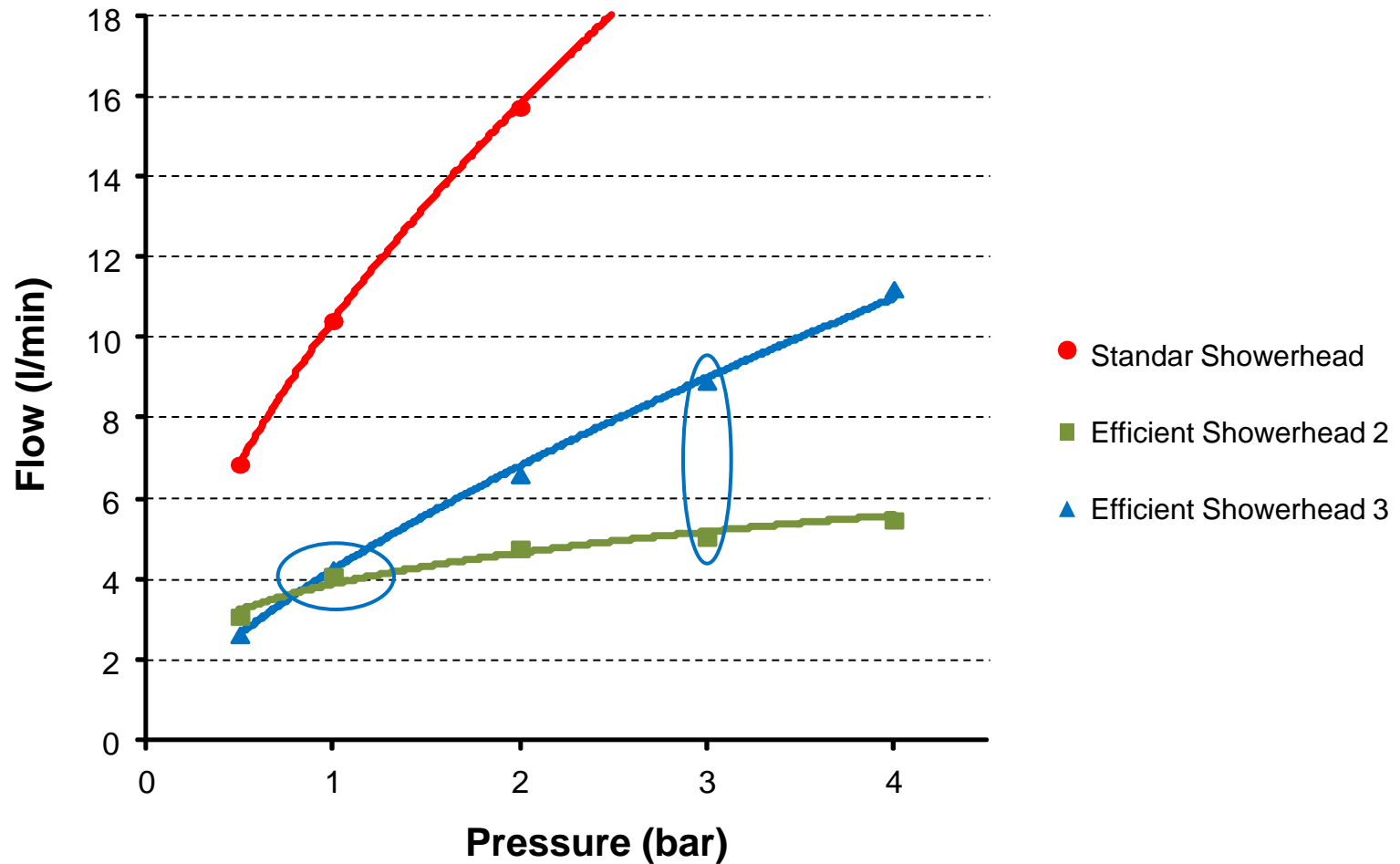
Efficient aerator:

—◆— A = 0.0640011

Aerators

Pressue (bar) vs Flow (l/min)

SOME IMPORTANT UNCERTAINTIES

Technical Features of Fixtures - Showers

SOME IMPORTANT UNCERTAINTIES
Technical Features of Fixtures - Showers

SOME IMPORTANT UNCERTAINTIES

Practical problems when retrofitting

Breaks when replacing old devices caused by lime build-up
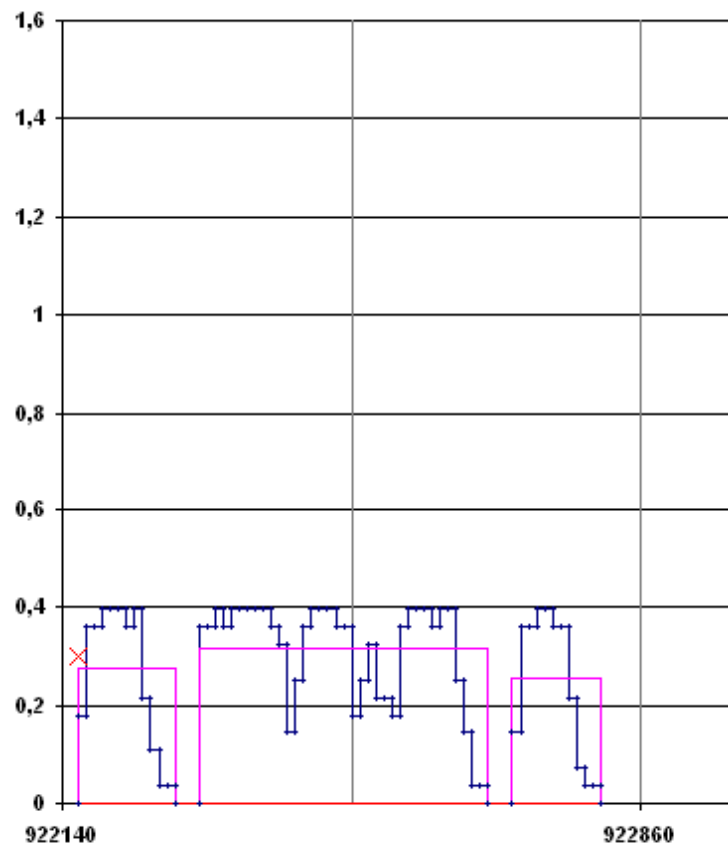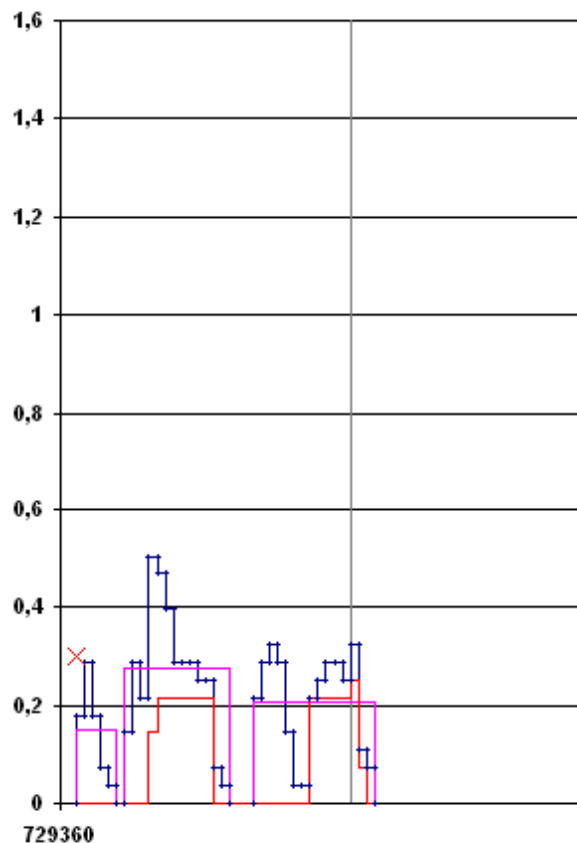
SOME IMPORTANT UNCERTAINTIES

Practical problems when retrofitting

… and the gas-fed individual
water heater does not work

SOME IMPORTANT UNCERTAINTIES

Practical problems when retrofitting

SOME IMPORTANT UNCERTAINTIES

The preassure really available

Factors that influence the real preassure available at the water consumption point:

- Age and condition of the indoor piping system

- Average pressure of distribution network

- Existance of private roof tanks

SOME IMPORTANT UNCERTAINTIES

Unexpeted response by users

Desarrollo de una experiencia piloto de promoción de productos ahorradores de agua mediante vales de descuento, en los meses de noviembre y diciembre de 2005. Consistió en el envío de una carta a una muestra de 1.000 abonados de   con una invitación expresa a ahorrar agua mediante la instalación de algún producto eficiente en su hogar, para lo que se les facilitaba un cupón de descuento de 10 euros por la compra de cualquiera de esos productos, que podían presentar en los comercios adheridos al Plan. Se adjuntó a la carta el tríptico de tecnologías ahorradoras de agua, donde aparecía la relación de los comercios colaboradores.

La campaña se desarrolló en el tiempo y forma previstos, pero sólo se canjearon cinco vales. Esto hizo que se considerara que campañas de este tipo más generalizadas no lograrían una respuesta mínimamente satisfactoria en lo que se refiere al ahorro de agua. Los comercios se mostraron dispuestos a seguir colaborando en iniciativas de ese tipo, aunque la escasa repercusión no logró estimular la demanda de productos ahorradores.

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Stage 1

Sample selection

37 appartments of similar size, characteristics and occupation

They are devided into two groups:

Treatment: 27

Control: 10

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Stage 1

Stage 2

Water use metering before fixtures replacing

Records daily taken

AMR system

Duration: 3 months

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Stage 1

Stage 2

Stage 3

Selection of efficient fixtures to install

Fixtures considered: Taps
Showers
Toilets

Several manufacturers and models were selected

10 different kits were prepared

Replacement were performed by professional plumbers

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Stage 1

Stage 2

Stage 3

Stage 4

Water use metering after fixtures replacing

Records daily taken

AMR system

Duration: 3 months

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Evaluation of savings

- Each valid daily record is treated independently from the particular household

- No distinctions between different efficiency kits

CASE STUDY

Pilot test with 30 appartments

Mediterranean Spanish city

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Evaluation of savings

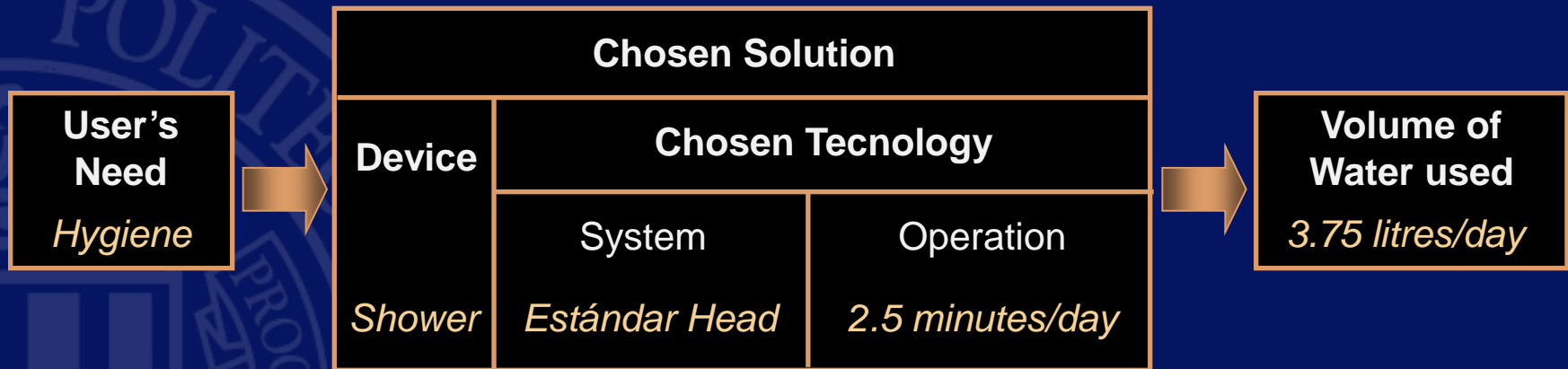|	n	q	s	n	q	s
Treatment	2019	374	195	1692	351	153
Control	536	362	136	493	375	133
Difference	-11			24		
Conf. Interval	[-26, 2,6]			[9,9, 37,6]		
Savings	35 l/d (9,4%)					

Now, how can we get into each fixture individually?

GETTING INTO DIFFERENT WATER END-USES

1st Way - A Water Consumption Model

A table like this is fulfilled for each end use:

User's Need	Chosen Solution			Volume of Water used
	Device	**Chosen Tecnology**		
		System	Operation	
Hygiene	*Shower*	*Estándar Head*	*2.5 minutes/day*	*3.75 litres/day*

Then it is combined with water meter records, and a final table is obtained:

End-Use	%	Consump. l/cap/day	Tech. Features	Daily use/cap
Toilet	32	48.0	9 l/flush	5.333 flushes
Taps	24	36.0	12 l/min.	3.0 minutes
Shower	25	37.5	15 l/min	2.5 minutes
Washer	13	19.5	60 l/load	0.325 loads
Dishwasher	2	3.0	25 l/load	0.120 loads
Other	4	6.0	-	-
TOTAL	100	150.0	-	-

1st Way - A Water Consumption Model

CUESTIONARIO CONSUMO DE AGUA

BUENOS DÍAS/TARDES, SOY UN ENTREVISTADOR/A DE LA EMPRESA XXX. ACTUALMENTE ESTAMOS REALIZANDO UN ESTUDIO PARA XXX SOBRE COMPROBACION DE LOS PATRONES DE CONSUMO DE AGUA EN LA COMUNIDAD XXX. SUS RESPUESTAS SE TRATARÁN CON ABSOLUTA CONFIDENCIALIDAD SEGÚN LA LEY DEL SECRETO ESTADÍSTICO Y SÓLO SE ANALIZARÁN DE FORMA AGREGADA. MUCHAS GRACIAS POR SU COLABORACIÓN

BLOQUE: EQUIPAMIENTO

1. ¿Podría Vd. decirme de que tipo es su vivienda, de los que le menciono a continuación?

Chalet/casa individual con parcela propia.......................................1
Chalet/casa individual con parcela común......................................2
Chalet adosado/pareado con parcela propia 3
Chalet adosado/pareado con parcela común 4
Chalet/casa sin parcela...5
Piso en bloque de viviendas..6
Duplex en bloque de viviendas..7
Apartamento/estudio en bloque de viviendas.................................8
NS/NC...0

2. Y ¿cuál es la antigüedad de su vivienda?

3. Y ¿cuánto tiempo llevan viviendo en esta casa?

	P.2	P.3
	Antigüedad	Llevan viviendo
Menos de un año	1	1
De 1 a 5 años	2	2
De 5 a 10 años	3	3
De 10 a 15 años	4	4
De 15 a 20 años	5	5
De 20 a 30 años	6	6
Más de 30 años	7	7
NS/NC...	0	0

4. Esta vivienda la tiene en propiedad o es alquilada?

Propiedad..1
Alquilada 2
NS/NC...0

65. Sabiendo que los ingresos familiares están alrededor de 150.000 pesetas mensuales, ¿los ingresos familiares de su hogar son...?

Muy superiores (más del doble)..1
Superiores 2
Alrededor de esa cifra..3
Inferiores 4
Bastante inferiores (menos de la mitad)...5

(Entrevistador si no contesta a los ingresos codificar el aspecto/ valor de la vivienda)

Valoración muy alta/ muy cara...1
Valoración alta/ cara 2
Valoración media/ precio medio 3
Valoración baja/ barata..4
Valoración muy baja/ muy barata...5

66. Por último, ¿estaría Vd. dispuesto a que le instalaran un contador individual de última tecnología gratuitamente que registre su consumo con mayor precisión?

Sí................................ 1		N.S./N.C.................... 0
No 2		

2nd - Direct Water Use Monitoring

The other way:

Direct monitoring at the same user's water meter.

Advantages: Accurate results

Disadvantages: High costs

2nd - Direct Water Use Monitoring

1. Replacing meters

2. Data collection

By means of:
- Pulse-emitters
- Data-loggers

- 1 pulse is sent per 0.1 litre accounted

- Pulses (volume) are stored by the logger every 10 seconds

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2nd - Direct Water Use Monitoring

1. Replacing meters

2. Data collection

3. Data process

By this way, different end uses are identied and quantified

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GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

1. **Replacing meters**

2. **Data collection**

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GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

1. **Replacing meters**

2. **Data collection**
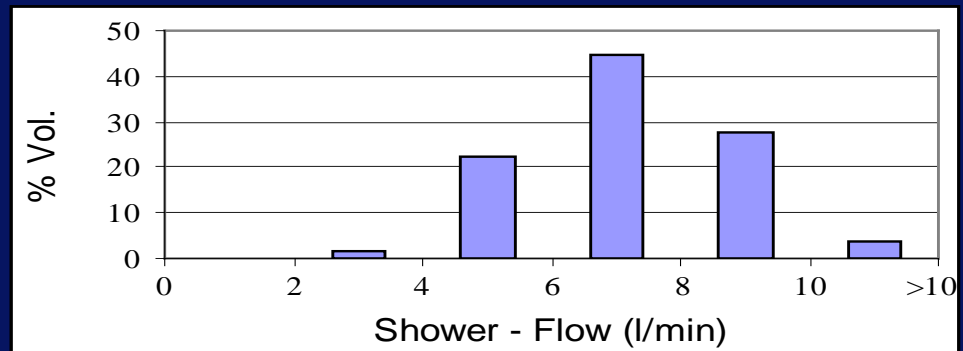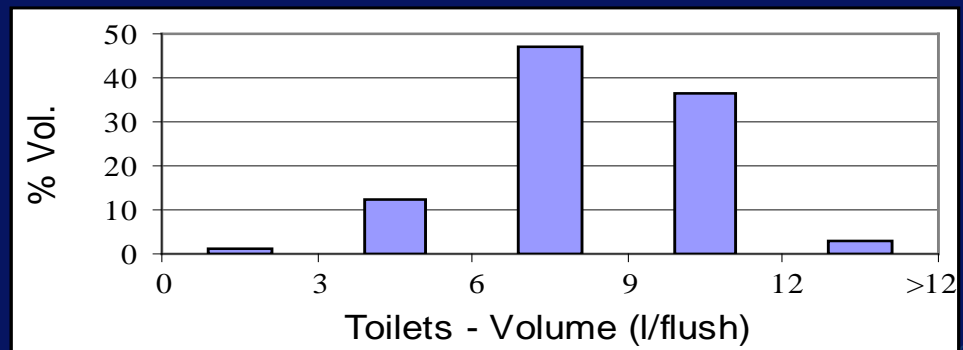
3. **Data process**

4. **Final results**

When every use is analysed, we can get:

- General results

General Results

- Leakage (14%)
- Dishwashers (0.5%)
- Washers (7.7%)
- Faucets (30.3%)
- Toilets (21.8%)
- Showers (25.7%)

GETTING INTO DIFFERENT WATER END-USES

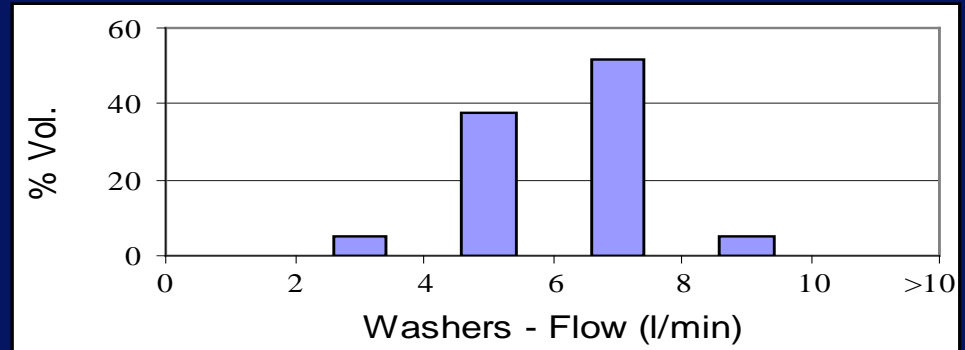## 2nd - Direct Water Use Monitoring

1. Replacing meters
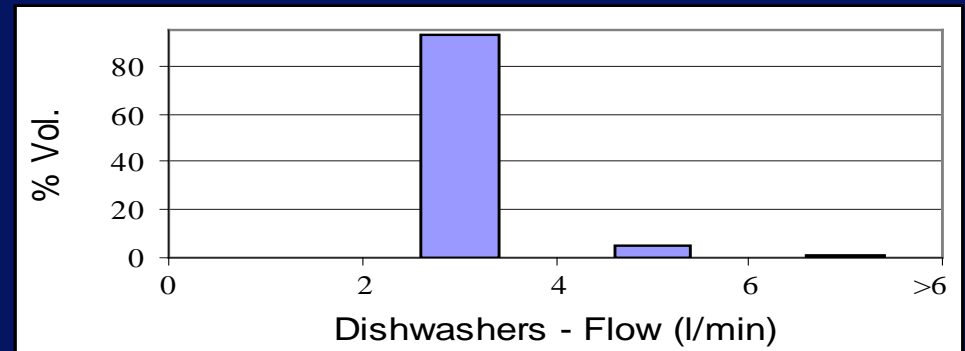
2. Data collection

3. Data process

4. Final results

When every use is analysed, we can get:

- General results

- Flow ranges for every end-use

2nd - Direct Water Use Monitoring

1. Replacing meters

2. Data collection

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4. Final results

When every use is analysed, we can get:

- General results

- Flow ranges for every end-use

Leakage
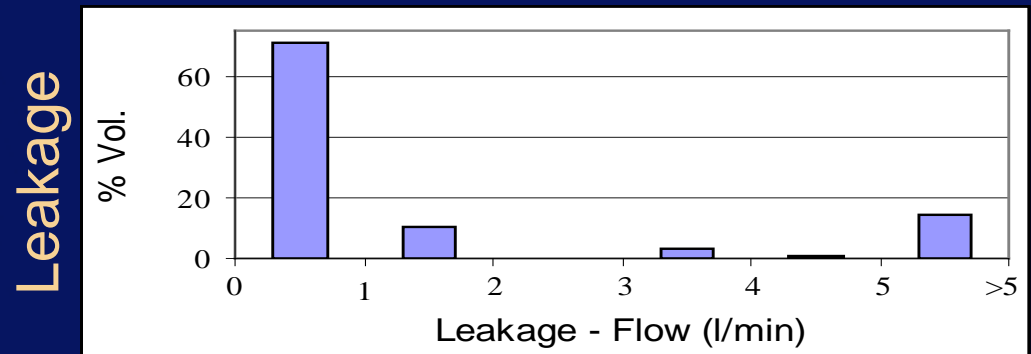
2nd - Direct Water Use Monitoring

By processing stored data, water consumption profile can be obtained.

Identification of water uses

| Double Toilet Flushings | + | Faucets | + | ? |

GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

By processing stored data, water consumption profile can be obtained.
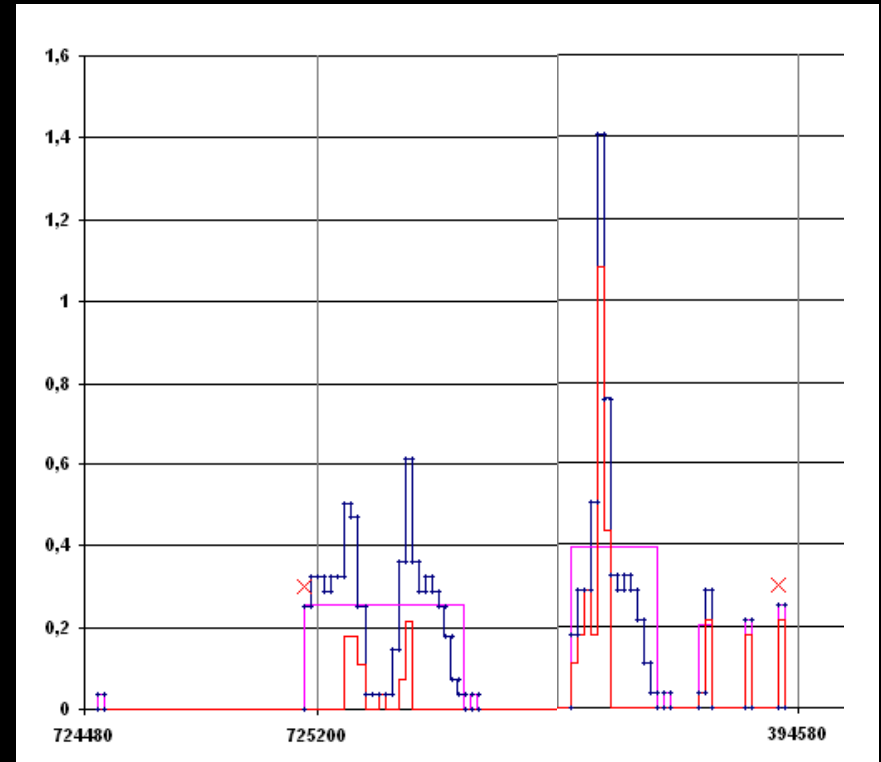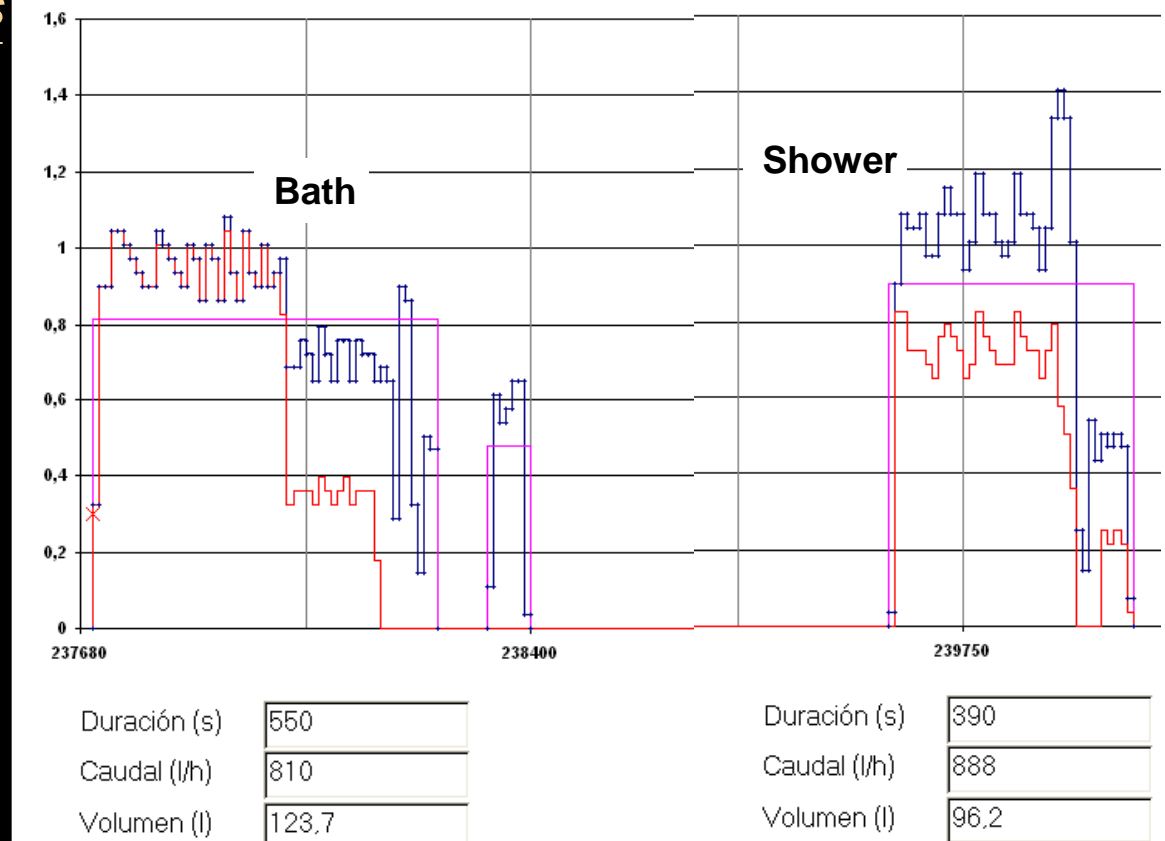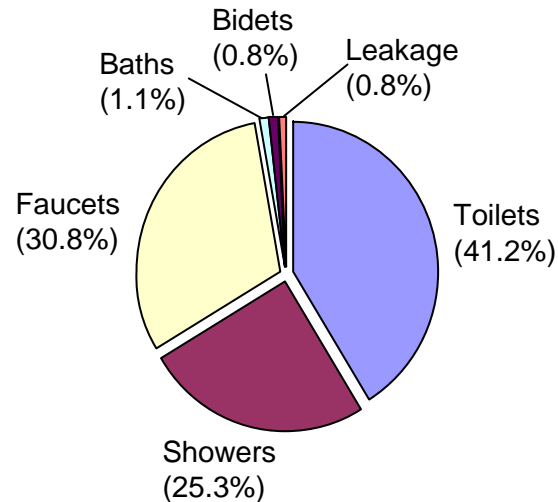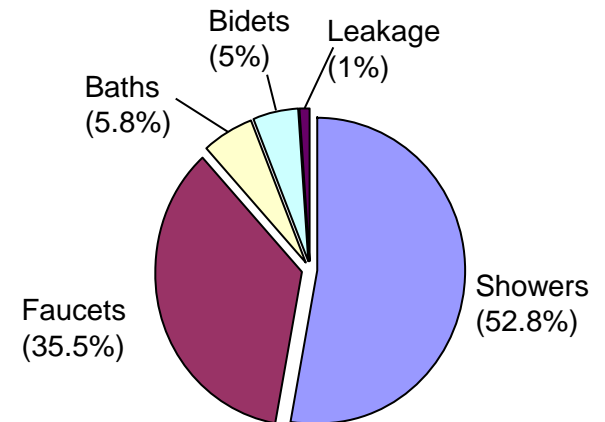
Identification of water uses

Showers

+

Baths

Bath

Shower

Duración (s)	550
Caudal (l/h)	810
Volumen (l)	123,7

Duración (s)	390
Caudal (l/h)	888
Volumen (l)	96,2

GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

Percentages according to end use and water temperature

COLD WATER (62%)

Baths (1.1%)
Bidets (0.8%)
Leakage (0.8%)
Faucets (30.8%)
Toilets (41.2%)
Showers (25.3%)

HOT WATER (38%)

Bidets (5%)
Baths (5.8%)
Leakage (1%)
Faucets (35.5%)
Showers (52.8%)

TOTAL HOT+COLD (100%)

Bidets (3%)
Bath (2.9%)
Leakage (0.9%)
Faucets (32.4%)
Toilets (25.3%)
Showers (35.6%)
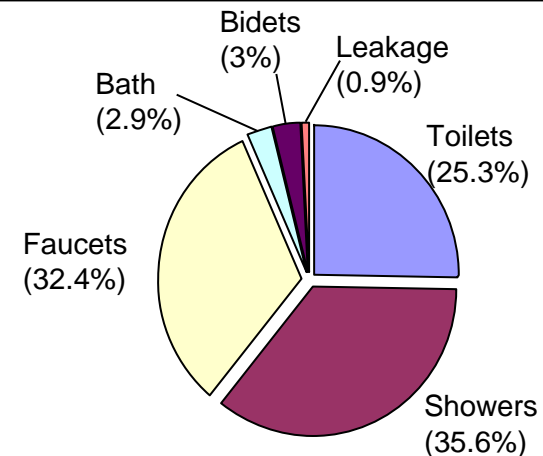
GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

By having metered each single water use, high quality information becomes now available

Volume per water specific use (litres/day/guest)							
	Faucets	*Shower*	*Toilet*	*Bath*	*Bidet*	*Leaks*	*Total*
Cold Water	17.0	14.0	20.4	0.6	1.0	0.4	53.4
Hot Water	12.1	18.0	-	2.0	1.7	0.4	34.2
Cold+Hot W.	29.1	32.0	20.4	2.6	2.7	0.8	87.6

Nº of uses (nº/day/guest)			
Faucets	*Shower*	*Toilet*	
		Full F.	*Partial F.*
5.9	0.7	4.8	1.1

GETTING INTO DIFFERENT WATER END-USES

2nd - Direct Water Use Monitoring

Comparison after replacing fixtures in 3 rooms:

	Water	VOLUME per end-use (litres/day/guest)						
		Taps	Shower	Toilet	Bath	Bidé	Leaks	Total
STANDARD Fixtures	Cold	17.0	14.0	20.4	0.6	1.0	0.4	53.4
	Hot	12.1	18.0	-	2.0	1.7	0.4	34.2
	Tot.	29.1	32.0	20.4	2.6	2.7	0.8	87.6
EFFICIENT Fixtures	Cold	11.7	13.8	17.0	1.1	0.1	0.6	44.3
	Hot	13.0	30.3	-	2.4	0.1	0.1	45.9
	Tot.	24.7	*44.1	17.0	3.5	0.2	0.7	**90.2

"Savings":   15%   *   17%

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2nd - Direct Water Use Monitoring

Comparison after replacing fixtures in 3 rooms:

	Taps	Shower	Toilet flushes		
			Total	Partial	'Extended'
STANDARD	5.9	0.7	4.8	1.1	-
EFFICIENT	5.2	0.8	0.6	3.3	0.1

Table header spanning: # of uses (nº/día/ocupante)
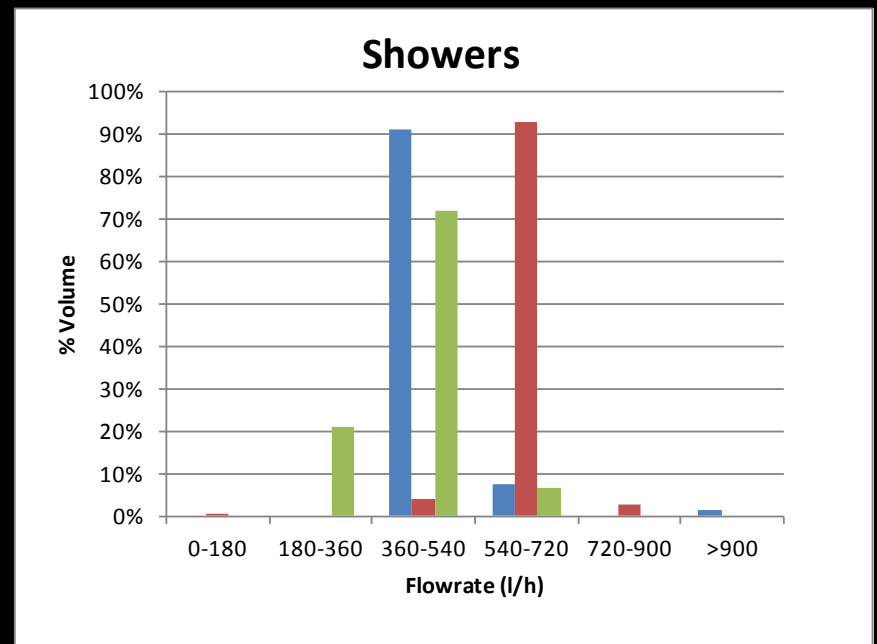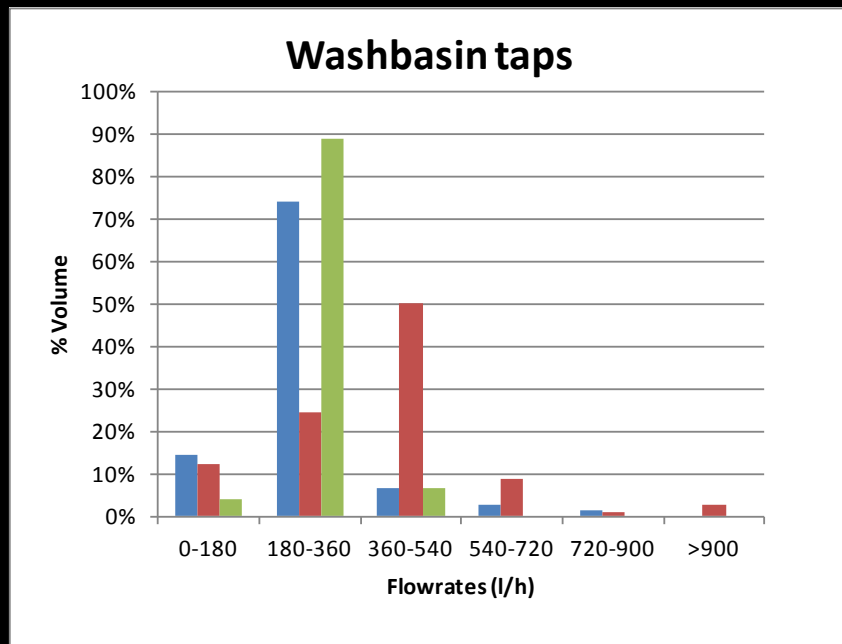
GETTING INTO DIFFERENT WATER END-USES
2nd - Direct Water Use Monitoring
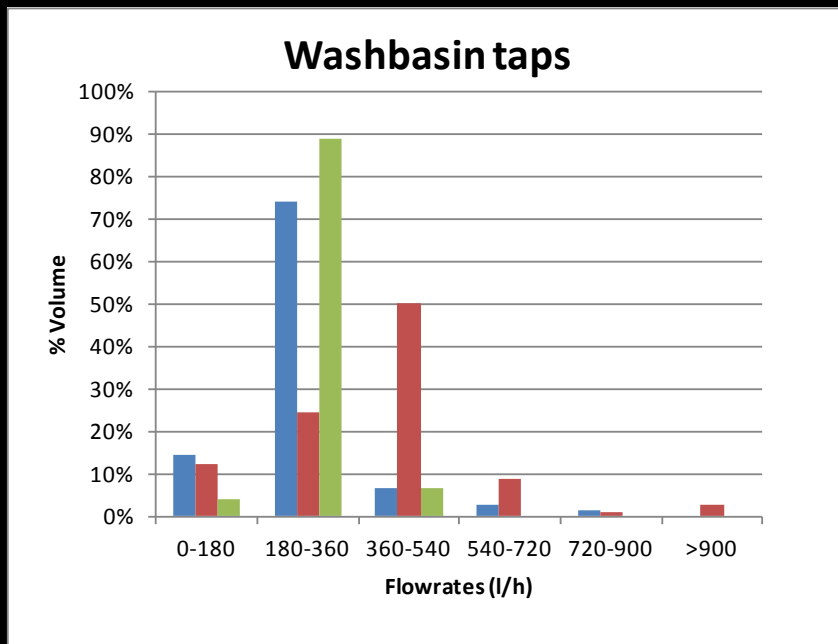
Comparison of consumption patterns in 3 different rooms:

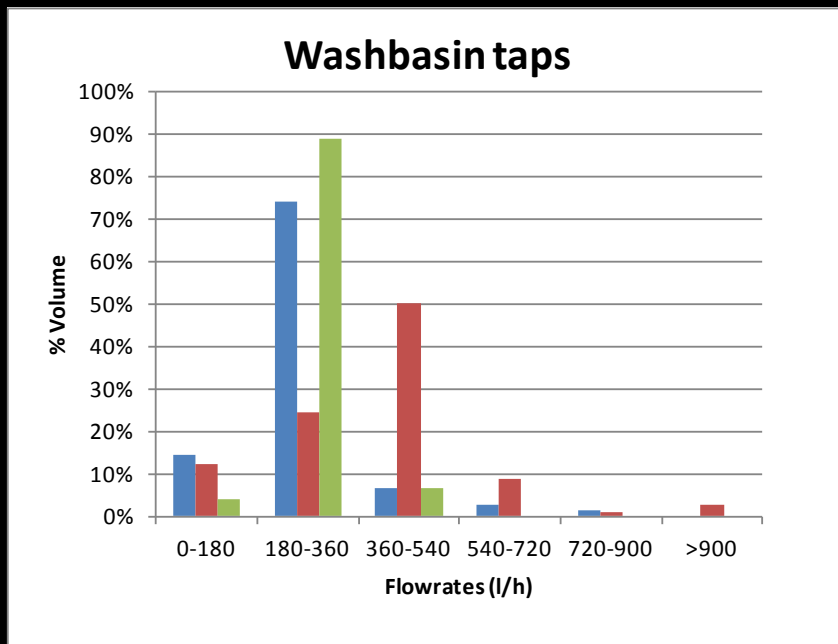Blue and green rooms look more water efficient than red room

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Comparison of consumption patterns in 3 different rooms:

Washbasin taps

Blue and green rooms look more water efficient than red room

2nd - Direct Water Use Monitoring

Comparison of consumption patterns in 3 different rooms:

Washbasin taps

However a mean difference analysis showed 13% (questionable) savings just for the blue room

CONCLUSION

UNIVERSIDADE DE AVEIRO

Seminar:

Water Efficiency

Aveiro. 30th May, 2012

- THANK YOU VERY MUCH -

UNCERTAINTIES AND PRACTICAL EXPERIENCIES

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CONTENTS

Water-efficient fixtures

Structure of a Water Demand Management

Program

Some uncertainties behind real efficiencies

Technical features of water fixtures

Other problems

Monitoring of end-uses

Assessing savings

Difference of means (2 groups)

Comparing before/after

Comparing water use patterns

Conclusion