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# Linking water consumption smart metering with census data to improve demand management

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# PRESENTATION OVERVIEW

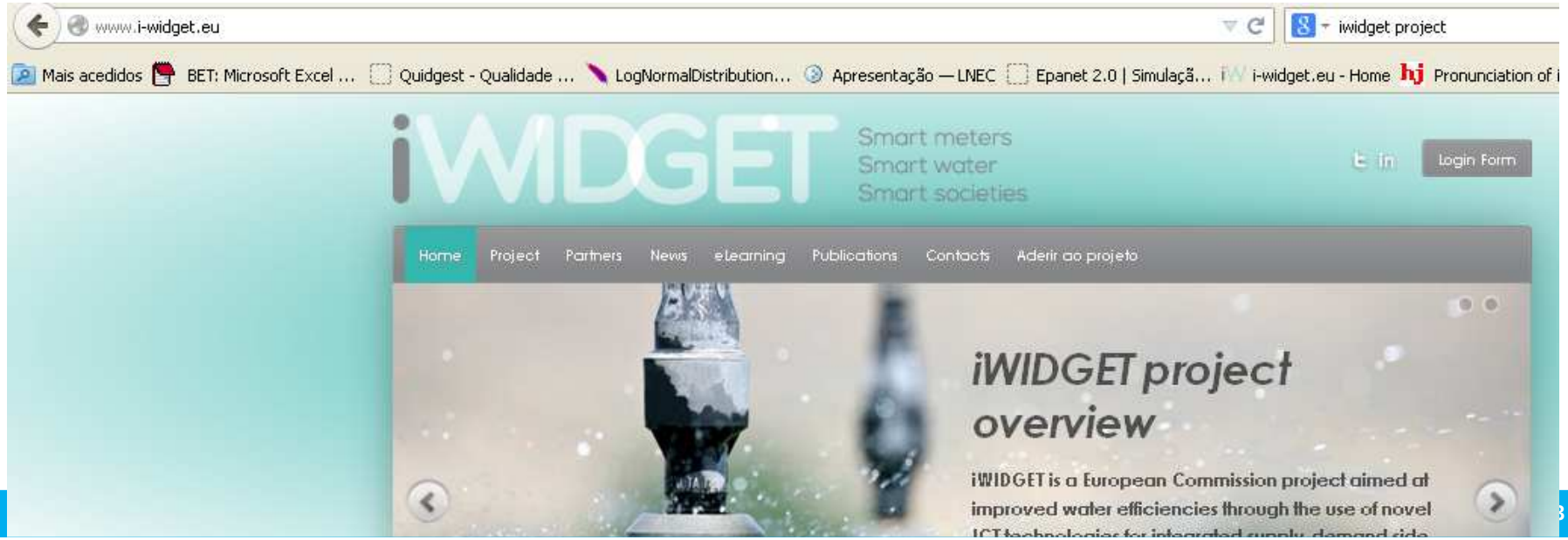
1. Why do we need to improve understanding about urban water consumption?

2. What approach to follow?

3. What do we obtain when we apply it to profile individual domestic consumption?

# IMPROVE UNDERSTANDING ABOUT URBAN CONSUMPTION AND KEY FACTORS: WHY?

- To improve water supply system planning, design, operation & maintenance
- To inform end-users about inefficient uses and promote behaviour changes
- To facilitate cooperation and awareness raising between consumers and the utilities

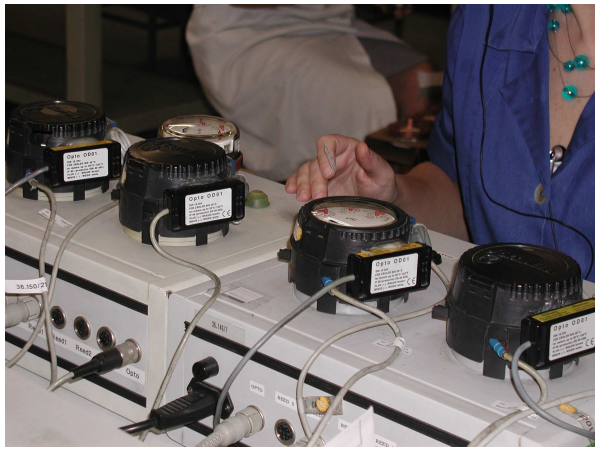


# IMPROVE UNDERSTANDING ABOUT URBAN CONSUMPTION AND KEY FACTORS: WHY?

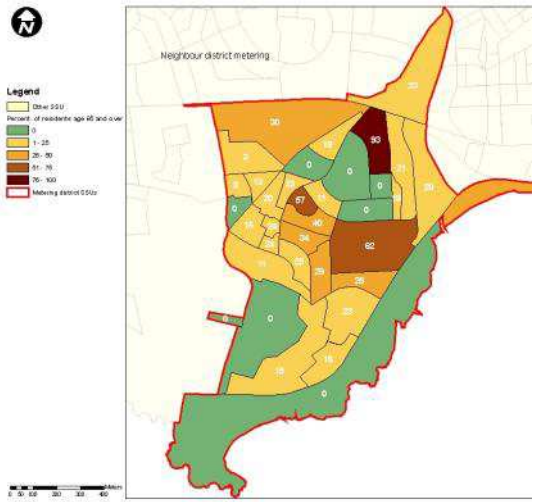
- Urban water consumption: domestic, non-domestic, water losses
- Domestic consumption (indoor&outdoor) = water use+ leakage
- Domestic consumption characteristics is dependent on local conditions
  - Socio-demographic factors
  - Economic factors
  - Consumption practices
  - Climate
  - Household devices
- Lack of general approaches to profile consumption

# IMPROVE UNDERSTANDING ABOUT URBAN CONSUMPTION AND KEY FACTORS: WHY?

- Smart metering technology
  - Enables utilities& consumers to access to more accurate consumption data, in real-time or near real-time
  - Provides the possibility to inform about consumption both locally and remotely



- Census data
  - Source of socio-demographic data (buildings, dwellings, families, individuals)
  - Data available in the public domain
  - Data available at small and homogenous area level (~ 300 households)



# THE APPROACH


- Consumption data
  - Data source: smart metering systems, SCADA systems
  - Spatial scale (individual, small areas, district metering areas)
  - Temporal scale (time step - 15 min.)
  - Monitoring period: 3 months
- Census data
  - Last census - 2011 (georeferenced socio-demographic data base)
  - Spatial scale: census unit (300 households)
  - Temporal scale: (time step: 10 years)

Not applicable to urban areas with important changes throughout the time!

# THE APPROACH


- Consumption data
  - Data normalization
  - Outliers detection
  - Data combination
- Census data
  - Data extraction
  - Data combination
  - Data statistics calculation
    - Building
    - Dwelling
    - Family
    - Individual

# THE APPROACH


- Consumption statistics calculation
  - minimum night consumption (leakage analysis)
  - daily average consumption, daily consumption pattern (water uses)
  - peaking factors (extreme values, design)
- Consumption scenarios identification
  - daily, weekly, seasonal
- Consumption data classification
  - cluster analysis

# THE APPROACH


- Census data reduction
  - Principal component analyses
- Consumption profiling
  - Correlation analysis (spearman)
  - Multiple regression analysis
  - Decision trees

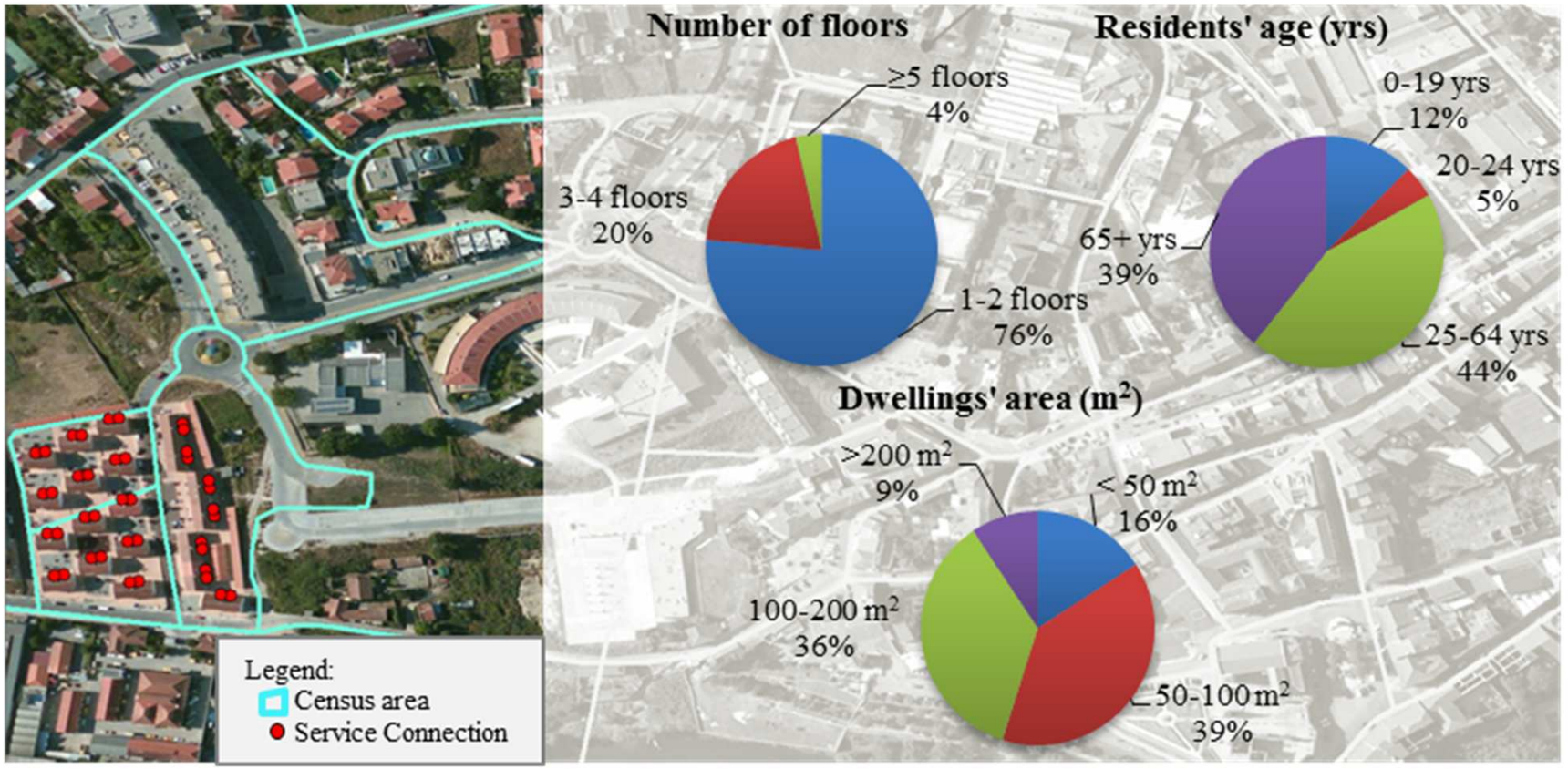
Approach successfully applied at DMA level

(Loureiro, 2010; Mamade, 2013)

# THE CASE STUDY: METERING & CENSUS DATA

- 311 households equipped with smart meters
- Households included in 18 census areas (3 DMA)

Water meter equipped with telemetry



# THE CASE STUDY: CONSUMPTION DATA

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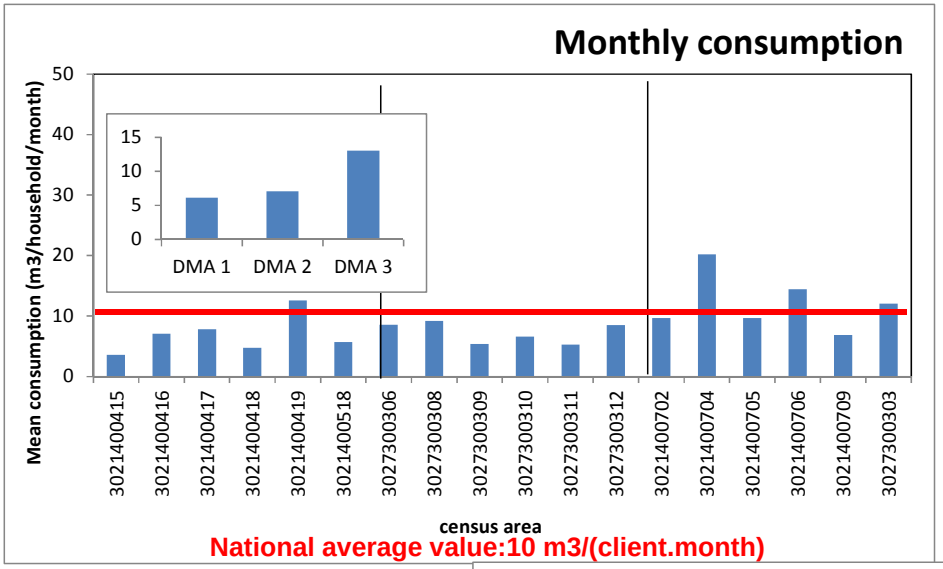
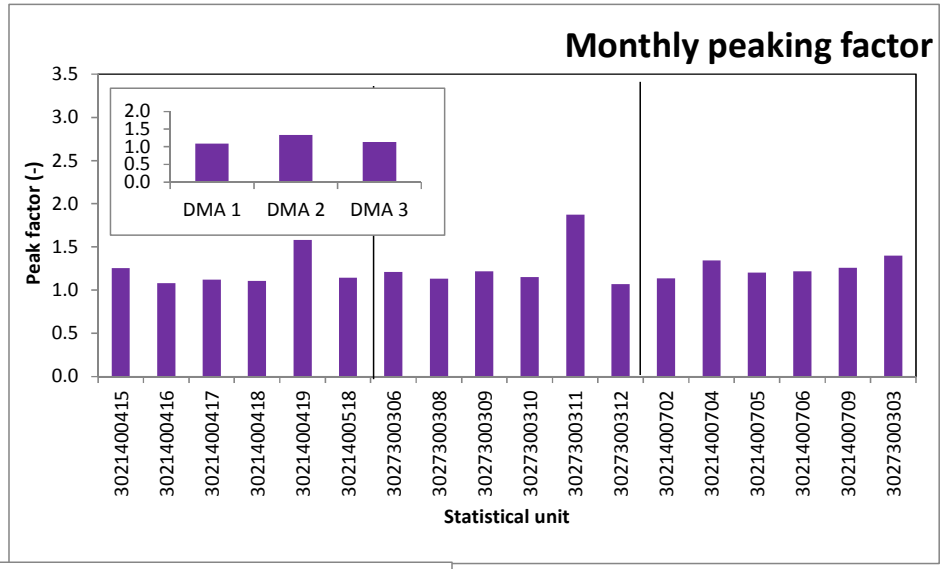
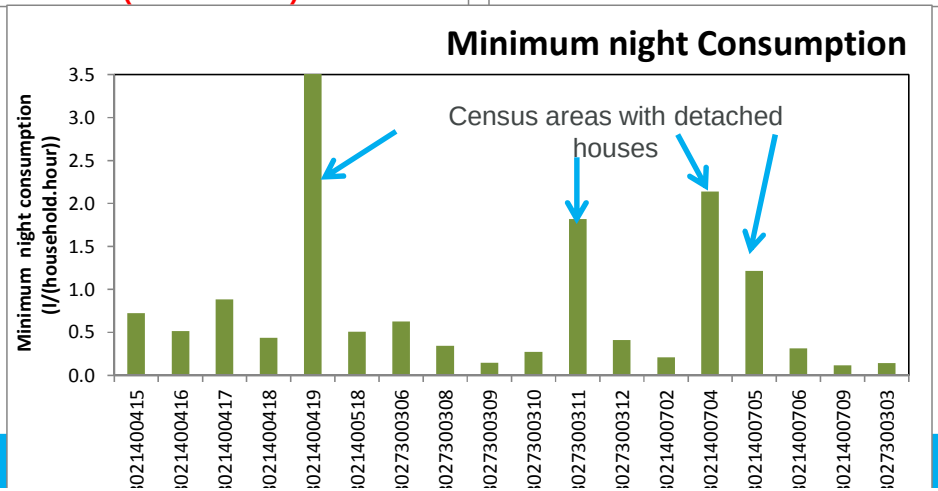
Data collection → Data processing → Data analysis → Consumption profiling



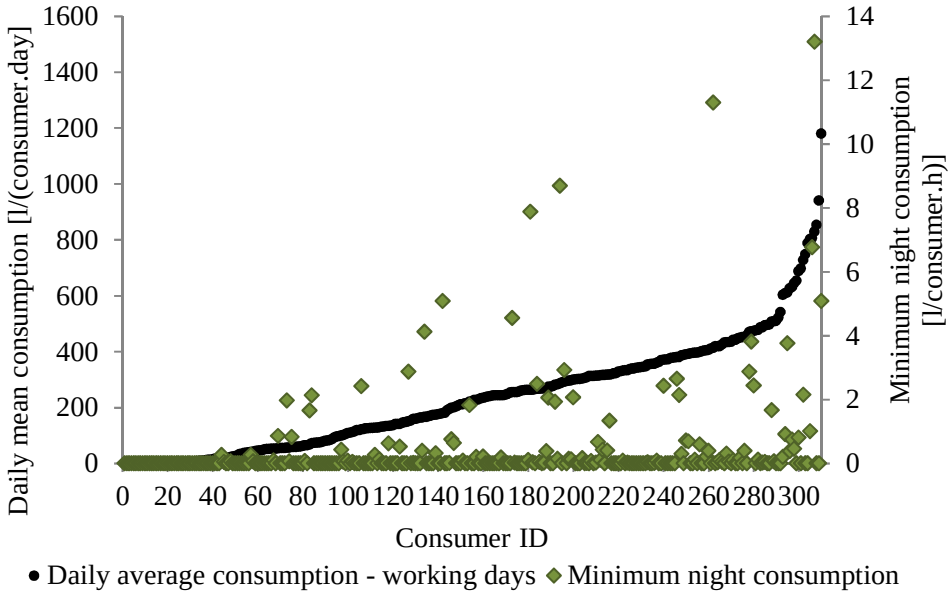



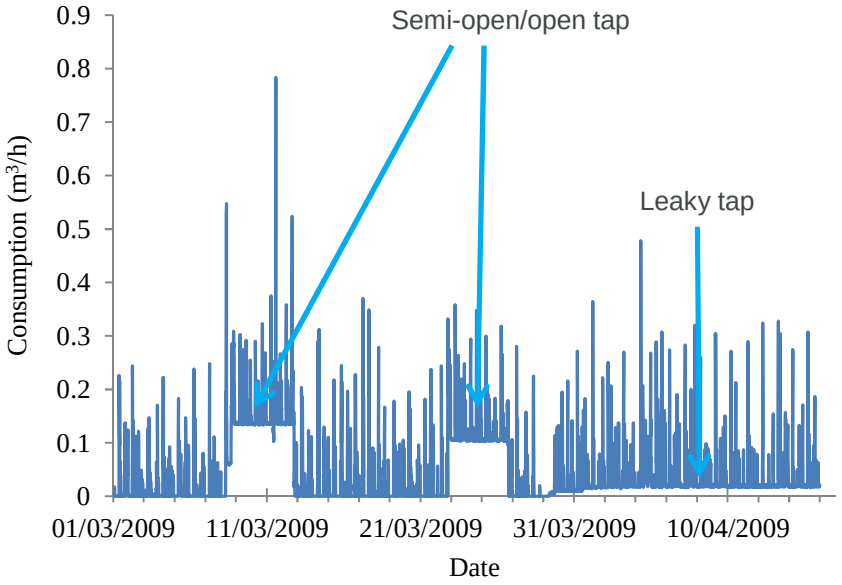



# THE CASE STUDY: CONSUMPTION DATA

Data collection → Data processing → Data analysis → Consumption profiling

- Daily average (indoor) consumption: 245 l/(client.day)
- Average night consumption (leaks): 0.4 l/(client.day)

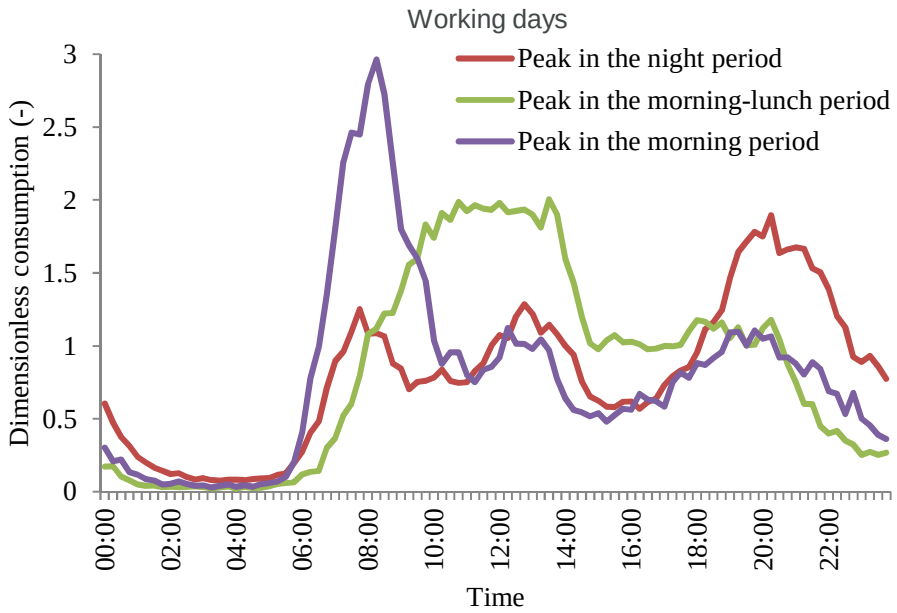


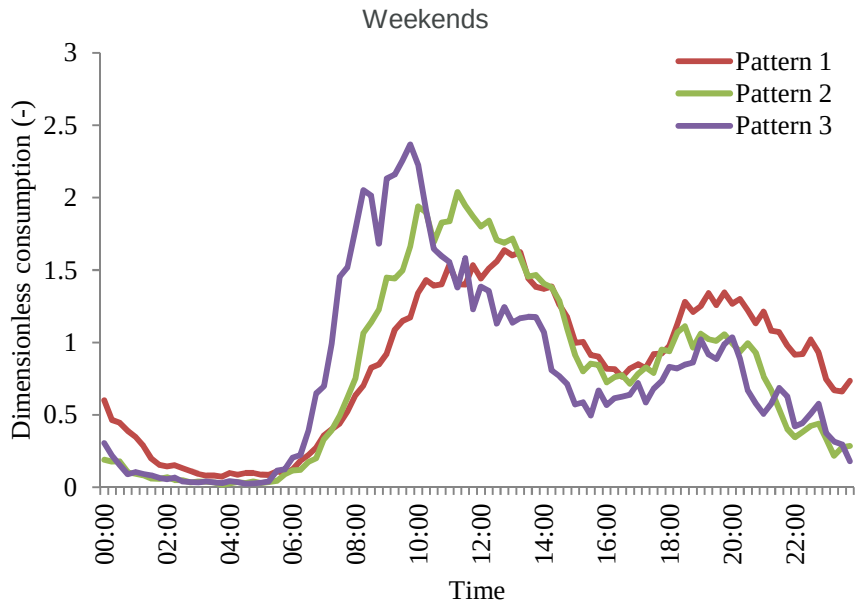



# THE CASE STUDY: CONSUMPTION DATA

Data collection → Data processing → Data analysis → Consumption profiling

- Daily consumption patterns were grouped
- Working days – pattern with “peak in the morning period” predominates (133 consumers)
- Weekends – daily patterns with lower variability



# LINKING WATER CONSUMPTION SMART METERING WITH CENSUS DATA

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Data collection → Data processing → Data analysis → Consumption profiling

| | Spearman's rho coefficient correlation | Rented middle size dwellings | Working middle size families | Working adults and school age population |
|---|---|---|---|---|
| **Working days daily patterns** | I) Peak in the night period | 0.71 ** | 0.81 ** | 0.82 ** |
| | II) Peak in the morning- lunch period | 0.67 ** | 0.68 ** | 0.65 ** |
| | III) Peak in the morning period | 0.69 ** | 0.63 ** | 0.74 ** |
| **Daily average consumption (l/client.day)** | I) High [787 l/c.day, N=19] | 0.20 ns | 0.40 ns | 0.33 ns |
| | II) Medium-high [411 l/c.day, N=71] | 0.64 ** | 0.72 ** | 0.55 * |
| | III) Medium [251 l/c.day, N=93] | 0.80 ** | 0.79 ** | 0.84 ** |
| | IV) Low [56 l/c.day, N=128] | 0.79 ** | 0.61 ** | 0.89 ** |

# FINAL REMARKS

- In the case study, it predominates consumers with lower-medium consumption- 245 l/(client.day)
- For working days, it predominates the pattern with “peak in the night period”
- For this consumption characteristics, the key factors were:
  - Rented middle size dwellings
  - Working middle size families
  - Working adults and school age population
- The results indicate that consumers may have already some water efficiency awareness
- Smart metering system allow detecting important inefficiencies (household leaks)
- Census data allows obtaining a first understanding about domestic consumption

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Thanks for your attention!

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