Conclusions

This paper presents an exploratory data analysis of the annual electricity consumption profiles from daily consumption data of a sample of 230 households with smart meters data to better understand the electricity consumption in the residential sector of a Southwest European city. This data was combined with an extensive door-to-door survey allowing a clustering analysis supported on their annual consumption profile and socio economic characteristics.

From the analysis we conclude that three major groups of determinants influence residential electricity consumption segmentation: physical characteristics of a dwelling especially year of construction and total floor area; electrical heating/cooling equipment and fireplaces ownership and use; and occupants profiles (mainly number of occupants and monthly income).

Despite the relevant outcomes of this work, there are some limitations, e.g. incomplete responses of data for some of the surveys, justified by difficulties regarding technical questions such as insulation type and thickness and difficulties to assess electrical appliances daily use, which have impacts on the clustering evaluation. Further work will encompass a complete assessment of the sampled households electricity consumption determinants available in the survey to identify the relative importance of each one within this smart meters data set including all clusters in the analysis performing a statistical analysis evaluating the significance in the differences across the clusters. Further statistical analysis will also be carried including daily electricity consumption for the year 2014.

The empirical work that we have conducted advances the knowledge on household consumption patterns. Besides of the identification of the factors characterizing selected electricity profiles, this paper discloses the importance of the future widespread use of

smart meters, which provide: 1) sufficient information to support the design and implementation of energy reduction policies targeting specific groups of consumers based on their socio economic characteristics and energy use profile. This knowledge could also be used as a starting point for utilities looking at peak shaving and electricity demand shifting inside households derived from market segmentation.

5 RESULTS

RQ.1) What are the methods to measure and analyze the power consumption of household applications in a real-time environment?

The research question is split into two complementing directions of research as follows:

Methods to Measure:

There are multiple traditional ways of assessing the meter and its data. The better way of assessing the meter is implemented by using Smart electricity meters rather than opting for traditional meters. The ancient and next generation methods of measuring the energy are explained in background work of this thesis paper. A literature review [2] has been performed to answer the question. The presentation of this part of the research question and its answer is mainly invoking an impressive knowledge for the people of various developed and underdeveloped nations regarding the fundamental changes among electricity market. From the literature survey and final suggestions of research, it was found that Smart Meter is the efficient meter to measure power consumption of household in real-time environment.

Analysis:

We acquired real time hourly power consumption data of 16 households and prices for April month from an electricity provider in the form of excel sheets. Time, price, cost, consumption, cumulative consumption, cumulative cost are tabulated in excel sheet. Lag-1 autocorrelation, price-cost correlation, price-consumption correlation, cost-consumption correlation, average, standard deviation and coefficient of variation of price, cost and consumption are calculated. Each and every factor specified above is tabulated for easy understanding. The data is arranged for all the 16 households and graphs are drawn for consumption, price, cost and cumulative cost. The parameters that are required are defined as follows.

- **Power**: Power is defined as the energy consumed per unit time.

  Power = e/t

  where e is energy consumption in KWh
  t is time

- **Cost (c):** Cost is calculated as the product of price and energy consumption. The unit of measurement is in monetary units.

  $c = p.e$

  where e is energy consumption in KWh
  p is price in monetary units/KWh

- **Average (m)**: It is defined as sum of different quantities divided by the total number of these quantities. It is formulated as follows:

  $m = 1/n. \sum_{i=1}^{n} X_i$

  Where n is total number of terms