

# **Television usage recommendations for energy efficiency: A Probabilistic methodology based on the Wasserstein distance**

A. Mateo González; A. Muñoz San Roque; A. Veiga Santiago; E.F. Sánchez Úbeda; F. Rodríguez Cuenca; J. Portela González; V. Guizien Martin

## **Abstract-**

This paper presents a general and interpretable methodology for delivering personalized energy-saving recommendations to household televisions. TVs, though often overlooked, account for 7% of household energy consumption, ranking as the fourth most costly category. The methodology extracts five easy-to-understand scalar features from historical TV energy consumption data, each representing a key usage aspect: OFF consumption, ON consumption, Daily Consumption, Session Duration, and Schedule of Consumption. It then employs a probabilistic approach based on the Wasserstein Distance to compare these features across TVs. Based on this comparison, two methods—percentage and elbow—are introduced for identifying TVs with significant deviations by feature, accompanied by tailored recommendations.

The methodology is applied to case studies in Spain (RC4ALL project) and the UK (REFIT dataset), with results compared. The percentage method flags 60% of TVs (15 in RC4ALL, 12 in REFIT), while the elbow method flags 56% (14 TVs) in RC4ALL and 40% (8 TVs) in REFIT. Selected TVs in RC4ALL show greater deviations, with ON power 2.5 times and OFF power 16 times above normal, compared to 2 and 7 times in REFIT. TVs’ extended daily usage and long sessions raise health concerns. This methodology can also be applied to devices beyond TVs.

**Index Terms-** Recommender system; Energy saving; Occupant behavior; Household appliances; Wasserstein distance; Data-driven

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