

Electricity-Water Nexus Analysis in Industrial Kitchen Appliance Water Consumption

Authors: *Lucas Pereira, Hugo Morais, Gonçalo de Morais*

Industrial Kitchens (IKs) are notorious energy and water consumers, particularly for cooking and cleaning. Surprisingly, while domestic consumption patterns receive ample scrutiny from researchers, the energy and water dynamics within IKs have largely remained uncharted territory. In this context, the nexIK project (<https://nexik.tecnico.ulisboa.pt>) aims to set itself as a one-of-a-kind real-world test bed for conducting exploratory research in IKs to understand how the Water-Energy-Food (WEF) Nexus can be leveraged to promote responsible resource consumption and cleaner energy Oliveira A. et al. (2023). This work unveils the preliminary findings of a data-driven methodology developed to explore the water consumption of wet IK appliances. The proposed methodology, driven by only aggregated water and electricity consumption data, comprises six key stages: 1) identification of the activations of the wet appliances in the electricity consumption signal; 2) linking these power surges to water consumption; 3) identification periods of simultaneous with water concurrent demand from these appliances; 4) isolating and subtracting baseline water use unrelated to the wet appliances, 5) quantifying the water volume associated with individual activations, and 6) determine the cumulative water volume consumed by each device. To validate this approach, electricity and water usage data from an IK in Portugal (Pereira L. et al., 2021) was employed, featuring two appliances— a glasswasher and a dishwasher— with water and electricity demand sampled at 5-second intervals over approximately two weeks. The evaluation yielded intriguing insights. First and foremost, despite both devices being used daily, the dishwasher has considerably more activations than the glass washer (1554 vs 417). Second, in both devices, two operation models can be distinguished, one that only consumes electricity and another that consumes electricity and water. Interestingly, water is only consumed in roughly 15% and 9% of the dishwasher and glasswasher activations, respectively. Finally, the results also show that about 50% of the dishwasher activations consume up to 12.4 Liters of water. In contrast, the water consumption of the glasswasher events displayed more diversity, with 21% of events requiring 1 to 4.2 liters and another 21% ranging from 10.95 to 14.27 liters.

Oliveira A. et al. (2023). On The Role Of Industrial Kitchens In Sustainable Energy Systems: The nexIK Vision. CIRED 2023 - The 27th International Conference and Exhibition on Electricity Distribution. CIRED 2023, Rome, Italy. <https://www.alspereira.info/pubs/cired-2023/>

Pereira, L. et al. (2021). FIKWater: A Water Consumption Dataset from Three Restaurant Kitchens in Portugal. *Data*, 6(3), Article 3. <https://doi.org/10.3390/data6030026>

Funding: EXPL/CCI-COM/1234/2021 (FCT)