The nexIK Vision: Data-Driven Insights for Energy Efficiency in Industrial Kitchens

Authors: *Lucas Pereira, Hugo Morais*

Industrial kitchens (IKs) stand out for their disproportionately high energy consumption, surpassing other commercial spaces, such as office buildings and retail stores, by a factor of 5 to 7 times per square meter. Nevertheless, despite the size and ubiquity of this industry, its role in the global quest for sustainable energy systems is still widely under-explored, particularly when it comes to the opportunities that emerge from the massive electrification of this industry. In this sense, the electrification of IKs has a solid potential to contribute to the energy transition targets by increasing the efficiency of the industrial kitchens' operation through better coordination between the use of appliances, the integration of small production and storage technologies, and even the participation in electricity markets. This work unveils the preliminary results of two data-driven methodologies developed in the scope of the nexIK project (https://nexik.tecnico.ulisboa.pt). The project positions itself as a unique real-world testing ground for pioneering research on unraveling how the Water-Energy-Food (WEF) Nexus can be harnessed to promote efficiency opportunities in IKs. To this end, the project spans several research aspects, including resource monitoring and eco-feedback, data-driven analysis and modeling, and energy resource optimization (Oliveira A. et al., 2023). The first methodology was developed to manage energy consumption in IK by tapping into the inherent flexibility of each appliance. It accomplishes this by modeling the IK devices based on two fundamental aspects: the required operating duration and the maximum power demand. The proposed methods were tested under two distinct optimization scenarios – one focusing solely on real-time data and another incorporating a one-hour lookahead period, using consumption data monitored from one IK during its daily routines. The second methodology seeks to create consumption profiles for different types of IKs. This methodology leverages actual IK device consumption by employing clustering techniques to identify the different modes of operation of the devices and Markov chains to model the most probable sequence of activations. The profiles generated for each appliance are summed in the final step to arrive at an aggregated consumption profile representing an IK. This methodology was tested with data from 15 devices, encompassing four refrigerators, two convection ovens, one blast chiller, and one dishwasher.

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/

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