Introduction

The approaching years will be challenging for the energy sector as energy resources which in nature are erratic, will experience a rise in distribution. In addition, domestic smart appliances and storage systems will make consumers an active part of the network [1]. Home Energy Management System (HEMS) could be used to reduce cost and pollution and provide grid services [2]. According to [3], most HEMS approaches hinge on optimization formulation; Thus, requiring valid short-term load forecasts (STLF). This motivated research [4], [5], [6], [7] to mainly focus on approaches such as Artificial Neural Networks (ANNs), support vector regression and Auto-regressive Moving-Average to produce STLF down to a single-household level. These methods are called point-forecasting methods as they usually generate a one-point forecast per time. As reported by [5], even state-of-the-art models can not outdo simple benchmarking methods as point-forecasting methods come with high errors since the consumption pattern of a household is highly irregular due to capricious human behaviour. On the other hand, probabilistic forecasting methods can be used to address this uncertainty by providing a distribution instead of the exact future value. Then a stochastic optimization could be implemented to consider this unpredictability of the consumption. This way, it can be said that the strategy is not only locally optimal but also global over the predicted distribution. Nonetheless, as stated by [9], this kind of approach has received scant attention in the literature. ANNs have been long used for point-forecasting. However, they are not often used in probabilistic electrical load forecasting. Density-estimating ANNs, however, have been successful to produce probabilistic forecasts in other fields where predictions could be unreliable [12], [13].

The objective of this study is to present the implementation of the Mixture Density Network (MDN) for modelling probability density.

In this paper, first, we briefly explain the methodology behind our proposed model in Sec. II. Next, in Sec. III we present our MDN model. In Sec. IV, we provide the results of our work as well as a comparison with other existing models. Lastly, we conclude our work in Sec. V.