Since the early 1990s, the process of deregulation and the introduction of competitive markets have been reshaping the landscape of the traditionally monopolistic and government-controlled power sectors. In many countries worldwide, electricity is now traded under market rules using spot and derivative contracts. However, electricity is a very special commodity. It is economically non-storable, and power system stability requires a constant balance between production and consumption. At the same time, electricity demand depends on weather and the intensity of business and everyday activities.

What is remarkable, however, is that the price uncertainty is continuing to grow because of structural changes constantly taking place in the power markets. For instance, in its Climate Policy 3x20 the EU is pushing for a significant increase of renewable energy sources in the energy mix. In some European countries wind energy production already exceeds 30% of total generation, in Western Denmark it can reach as much as 100% on a few days in a year. Under such conditions forecasting electricity spot prices is becoming more and more challenging. In the smart grid era, also electricity demand is more volatile and less predictable than ever before.

At the corporate level, electricity price forecasts – along with demand forecasts – are nowadays fundamental inputs to energy companies' decision-making mechanisms. The costs of over-/undercontracting and then selling/ buying power in the balancing (or real-time) market are typically so high that they can lead to huge financial losses or even bankruptcy. A generator, utility company or large industrial consumer who is able to forecast prices and demand with a reasonable level of accuracy can adjust its bidding strategy and its own production or consumption schedule in order to reduce the risk or maximize the profits in day-ahead trading. For a typical medium-size utility, improving the day-ahead demand forecasts by 1% leads to annual savings of roughly $1.5 million. With an additional price forecast, which allows to choose the cheaper of the two – the day-ahead or the real-time (i.e. balancing) market, the savings double. Poor demand and price forecasting, on the other hand, will lead to losses that eventually will be transferred to the end consumers.

A variety of methods and ideas have been tried for forecasting electricity prices and demand, with varying degrees of success. However, only very few authors have considered and examined prediction intervals or densities, i.e. the so-called probabilistic forecasts. On the one hand, electrical engineers are aware that high-quality probabilistic price forecasts would help utilities and independent power producers to submit effective bids, hence, help manage trading portfolios and improve risk management practices. On the other, the increasing popularity of probabilistic forecasts has not been observed so far in electricity market research. This is probably due to the increased complexity of the problem compared to point forecasting.

With this project we want to fill the gap and adequately address three outstanding challenges:

- the importance of considering fundamental price drivers and of an appropriate choice of the input variables in electricity spot (or forward) price models,
- the need for developing techniques for probabilistic (i.e. interval or density) forecasting of electricity prices and demand, both for power exchange bidding and risk management purposes,
- the need for a universal test ground involving the same datasets and the same robust error evaluation procedures.

Summing up, the project will contribute to the development of econometrics by analyzing existing and developing new methods for computing probabilistic forecasts of extremely volatile and seasonal time series. Given that error measures (or score functions) for evaluation of probabilistic forecasts are an underdeveloped area, the project will also contribute by providing guidance as to the appropriate choice of such measures in electricity markets. From the utilitarian point of view it will contribute to improving forecasting and risk management practices in the energy sector and in the longer run it may contribute to improving the financial stability of the firms operating in the power market and the national energy security.