

Research context and motivation

Introduction

- The deregulation of electricity markets in Italy has changed the shape of the economy in the electricity sector. In addition, particular features of Italian power market gain much attentions
- In the Italian Power market, the geographical market includes 7 foreign virtual zones, 6 geographical zones and 5 poles of limited production (national virtual zones). A stylized representation of the geographical market with the most relevant links between zones is reported in Figure 1

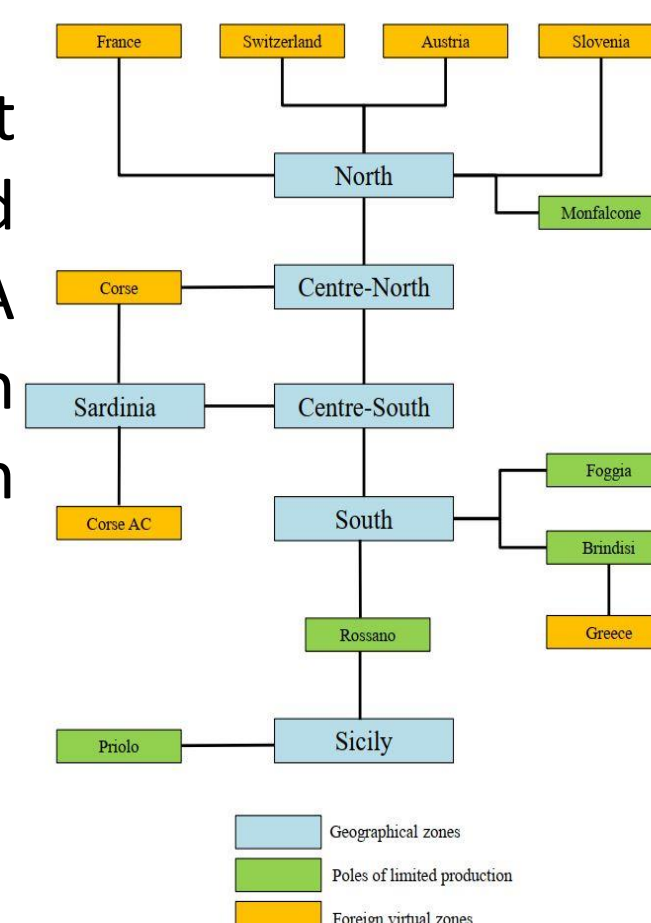


Figure 1. A stylized representation of geographical market

Most features of the Italian power market:

- Increment the penetration of Renewable Energy systems (RESs) and its side effects
- Zonal market structure
- Distance between the location of demand and generators causes congestions occurrence in different zonal pairs

Addressed research questions/problems

The main topics of the research are mainly focus on Italian Electricity market

- Preliminary analyses the impact of Renewable Energy systems (RESs) on power market**
 - Finding correlation between price and demand with/without considering the RESs production
 - Analysis of the impact of RESs on different zonal price
- A literature review about the Application of Machine Learning in Solar and Wind Power forecast**
- Forecasting electricity price in Italian day-ahead market (MGP) with different methods**

Novel contributions

Data science and machine learning techniques to:

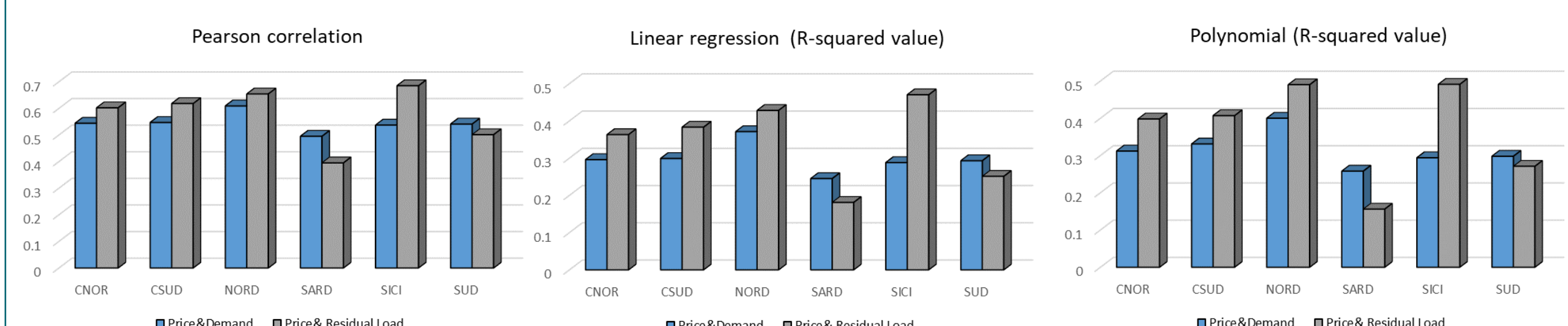
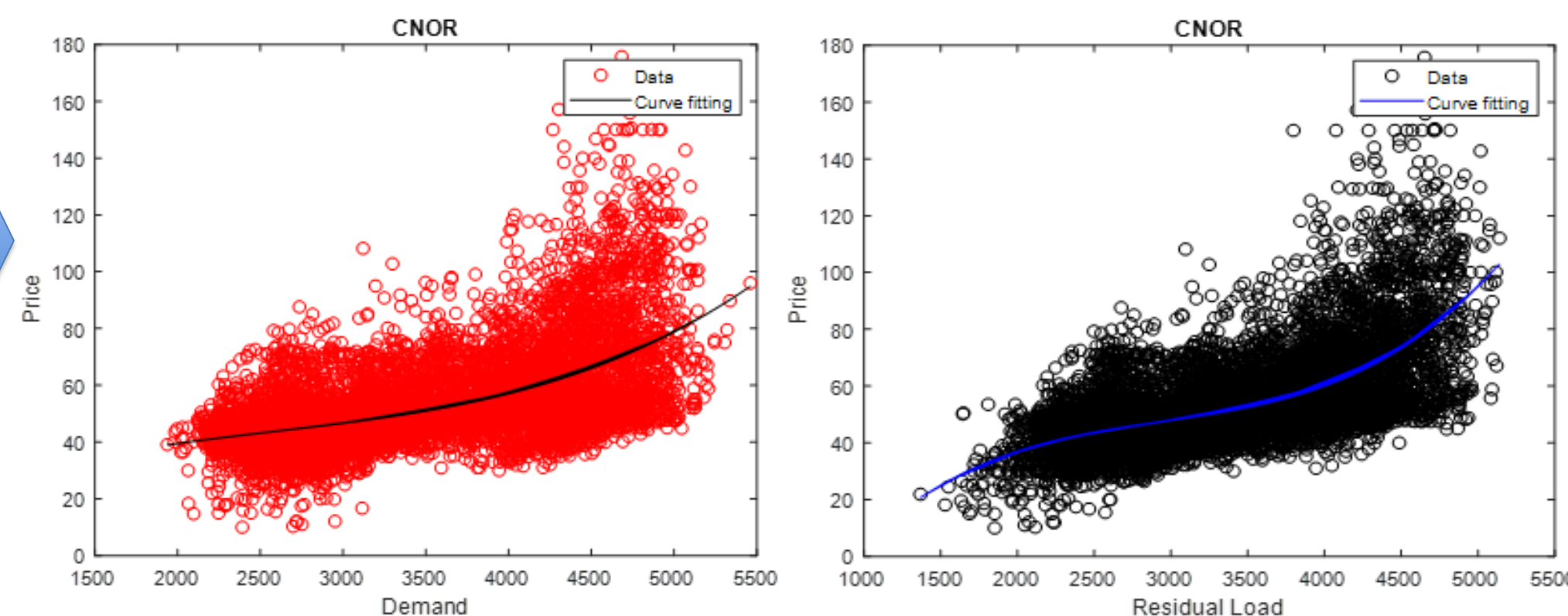
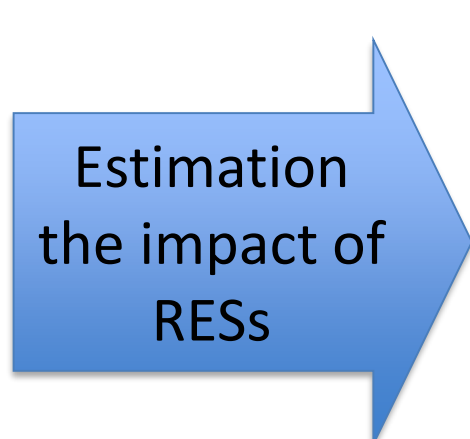
- Analyze the impact of RESs on the Italian power market
- Forecast different market results of the Italian power market (Price, Quantity,...)

Adopted methodologies

Correlation Analysis

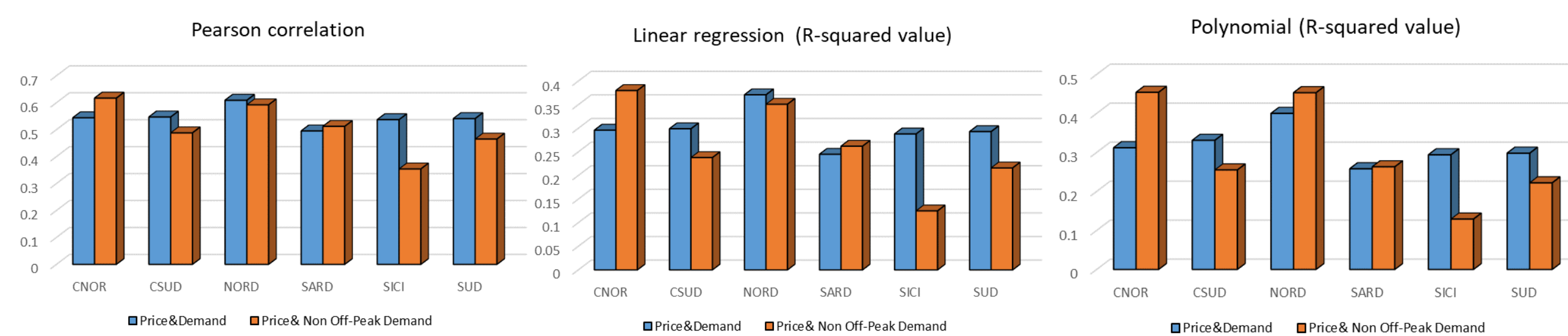
A correlation analysis have conducted on data in MGP and MSD market with the following methods:

- Pearson correlation
- Linear regression
- Polynomial regression

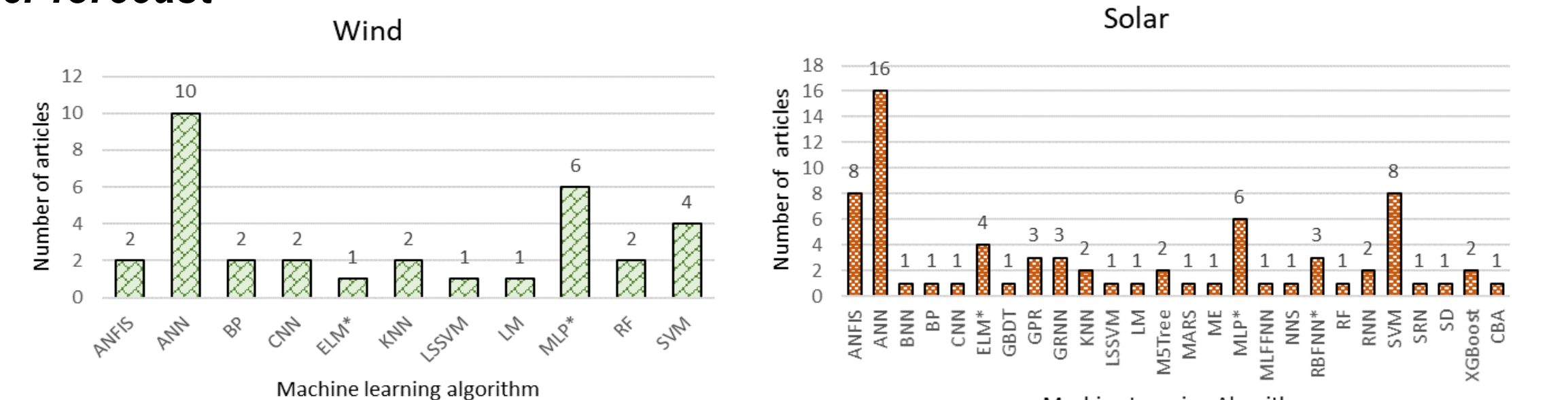


Submitted and published works

Estimation the impact of off-peak load on correlation between price and demand



A literature review about the Application of Machine Learning in Solar and Wind Power forecast



Forecasting day-ahead electricity prices

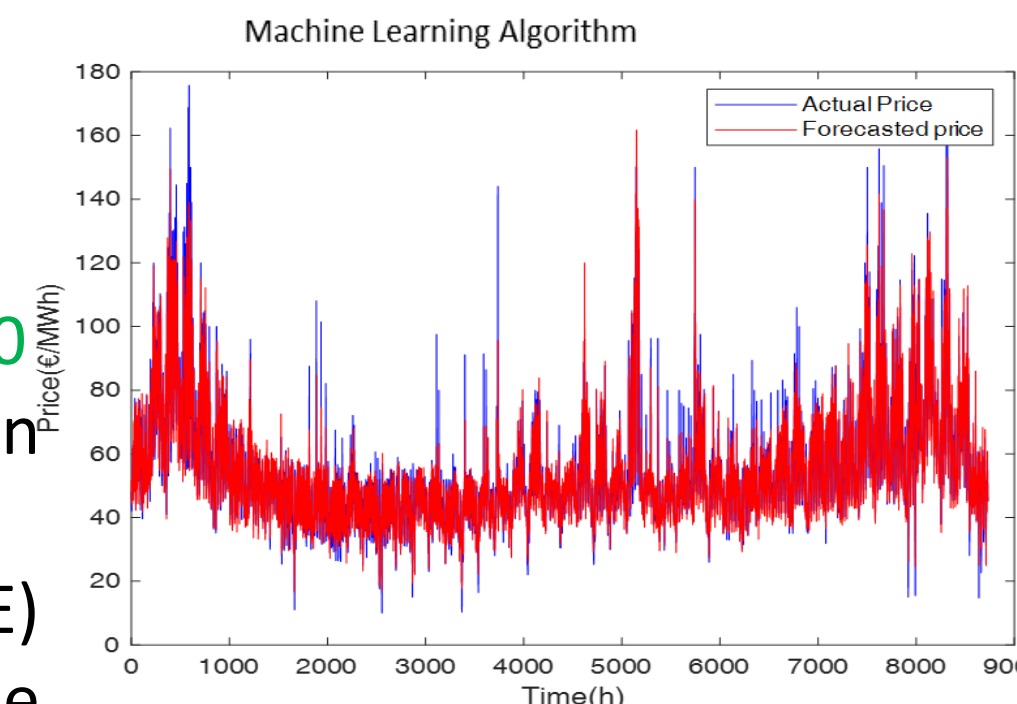
- Using Multilayer perceptron (MLP) algorithm
Number of hidden layer=2, Number of neurons=20
- Using K-Fold Cross Validation for test and train the dataset ($k=10$)
- Using performance metrics (MAE, RMSE, MPE) to evaluate and compare the accuracy of the forecaster.

Input Selection

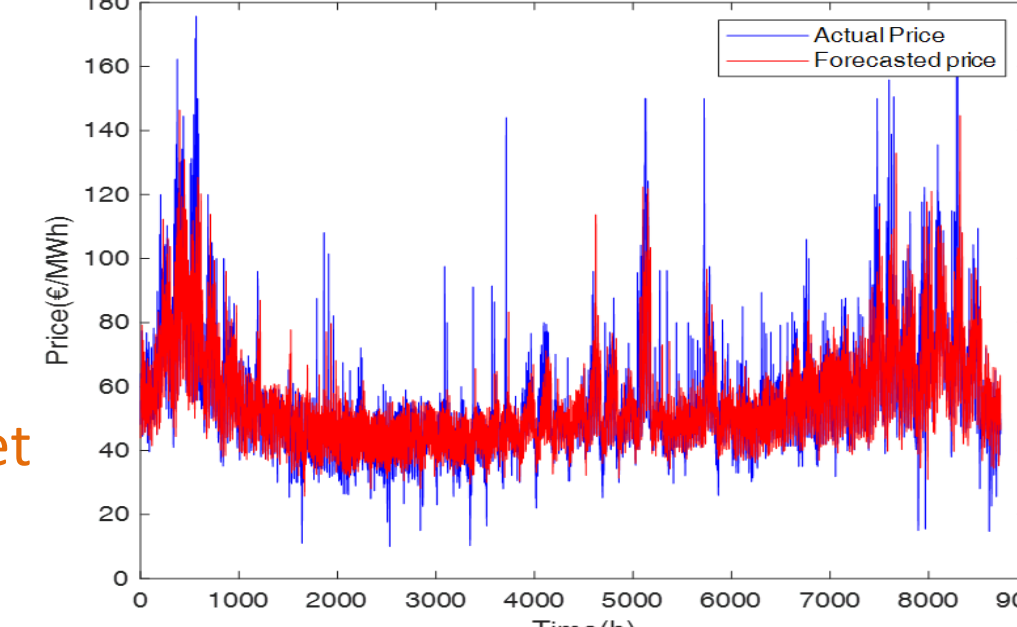
consider the following data as an input:

- Inputs
- 1-Day-ahead prices from the Italian power market
 - 2-Day-ahead grid load

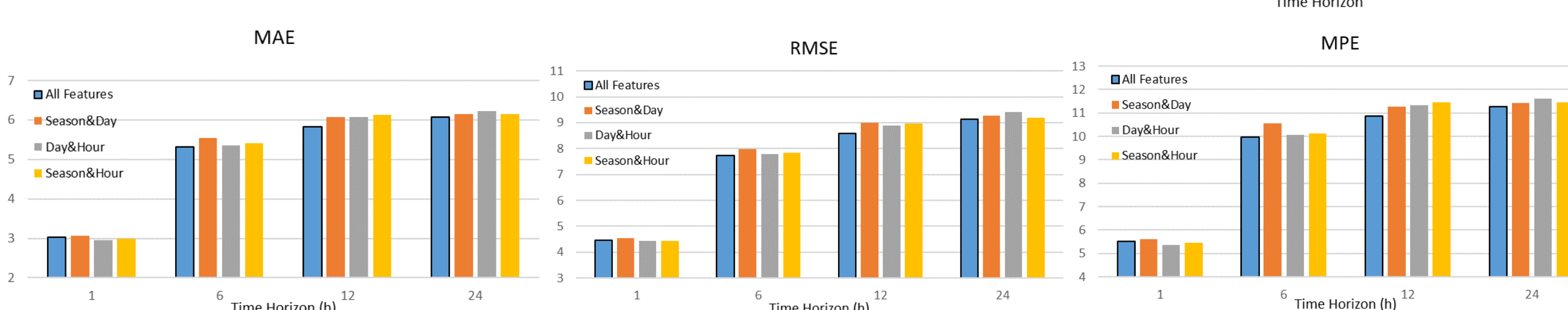
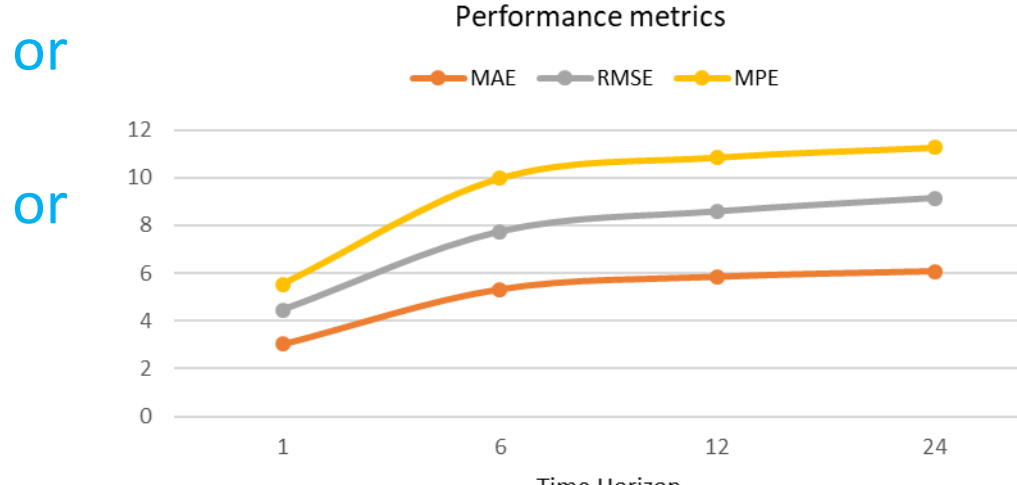
- Features
- 3-Last Six hours of MGP load and prices
 - 4-Type of the season (Spring, Summer, Autumn or Winter)
 - 5-Type of the day (weekend or weekday), peak or off-peak load
 - 6-Type of the hour (peak or off-peak load)



Actual price and forecasted price for time Horizon, 1-h



Actual price and forecasted price for time Horizon, 24-h



Future work

- Utilization of weather and other effective factors as an input in forecasting day-ahead electricity prices
- Mid-term probabilistic price forecasting and the test of alternative models, like the deep learning models
- Using machine learning algorithm to forecast the accepted/rejected bid/offer in Ancillary service market (MSD)
- Development of hybrid ANN model will be worked out to refine the forecasting.

List of attended classes

- 01LEVRV – Power system economics (05/10/2019, 15)
- 01QFFRV – Innovative techniques for optimization (08/03/2019, 20)
- 01LGSRV – Characterization and planning small-scale multigeneration systems (09/13/2019, 25)
- 01QUGIV – Energy in smart buildings (Date, 10)
- 02ITTRV – Generators and photovoltaic systems (Date, 25)
- 01SWPRV – Time management (02/02/2019, 2)
- 01RISRV – Public speaking (02/02/2019, 5)
- 02LWHRV – Communication (09/03/2019, 5)
- 01SYBRV – Research integrity (08/27/2019, 5)
- 08IXTRV – Project management (03/02/2019, 5)
- 01PJMRV – IT ethics (03/02/2019, 20)