Capstone Project – Project Summary

Master's in Business Analytics

Day-ahead prediction of photovoltaic power plant production

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1. Introduction and problem statement

E.ON Energiatermelő Kft. has been dealing with photovoltaic power plants (PVPPs) since 2018. Currently, it has several PVPPs around Hungary with over 10 MW built-in capacity. Most of these PVPPs are in the Feed-in Tariff (KÁT) renewable support scheme of the Hungarian Transmission System Operator (TSO), MAVIR. This system ensures 32 HUF / kWh produced electric power for the company.

Nonetheless, an additional bonus may be added based on the punctuality of the day-ahead schedule given on a 15-minute basis. Currently this job is mostly outsourced, however, a 500 kW PVPP, called Szigetvár Gamma, is scheduled by the company on its own.

The purpose of this project is to start developing a potentially scalable method and knowledge on photovoltaic day-ahead scheduling based on historical weather data and photovoltaic production.

2. Summary of the development

Lack of data is always the biggest issue for data science projects and there was a comprehensive data collection put in place for the success of this project. Getting historical weather forecasts could be very costly, and to be cost effective, a customized data collection method has been developed. Data has been gathered about historical production (from MAVIR Mérési Központ), clear sky irradiation (from Copernicus Atmosphere Monitoring Service) and day-ahead weather forecasts (from DarkSky API). The developed solution automatically generates a scheduling XML file each day with a model based on machine learning on the previous data.

The core of the project, the machine learning model has been tested with different kinds of algorithms and has been optimized throughout time. Iteratively, an initial model has been put into production already on 6th March. This model got updated with more and more sophisticated technologies, and it has been optimized based on more and more data.

The expected outcome has been to learn more patterns in the data of weather forecasts and the corresponding photovoltaic production of Szigetvár Gamma.

3. Results and learning curve

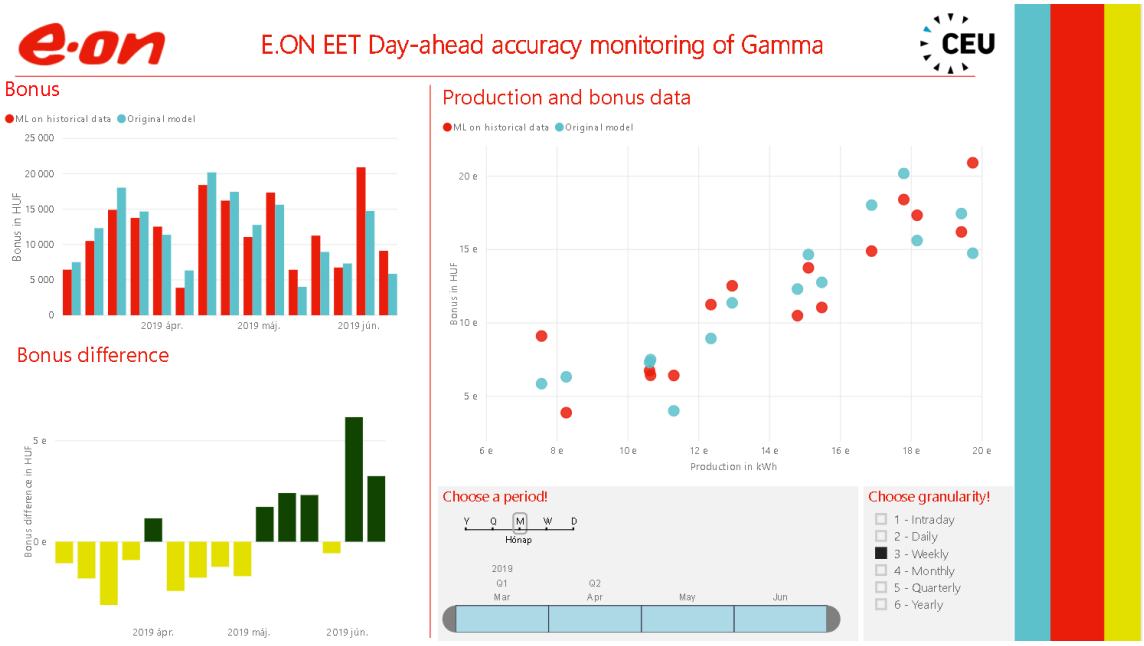

Figure 1: Screenshot of the developed dashboard to track the model results

Results can be monitored on a customly built developed Power BI dashboard solution, a screenshot of which can be seen on Figure 1.

The model has been producing better and better results as time went on. Figure 2 shows the extra generated profit by the machine learning in production, when compared to the original model. As it can be seen, the model started with 14% lower performance mostly due to lack of data and less sophisticated models. By June 2019, the model has been producing over plus 25% bonus compared to the original model. Moreover, by mid-June 2019 it seems like this month is going to be a record in bonus production of the power plant. Consequently, the project has already reached its break-even.

The project can be considered successful and several lessons can be learnt for future improvements and for scaling up.

4. Conclusions and scaling up the project

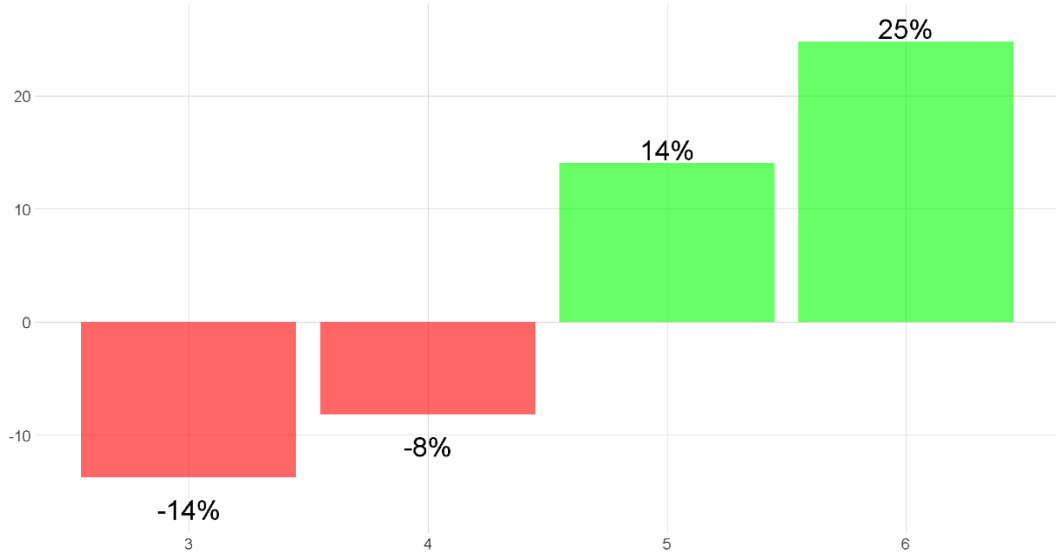

Figure 2: Bonus difference in % between the original and the developed model (March to June 2019)

The developed machine learning solution already provides higher bonus than the previous model in place. Future plans to maximize bonus range from general improvements of the model to scaling up the service for other PVPPs of the company.

At the beginning there was no available data, however, gradually more and more data has been collected regarding day-ahead weather forecasts and the corresponding photovoltaic productions. To enhance scalability of the project, there has been a daily automated weather data forecast save implemented for all the photovoltaic power plant locations of E.ON Energiatermelő Kft. This way, the project can be better scaled up to the rest of the power plants of the company.

When legislation will include extra fee for schedules out of a tolerance interval, the importance of such projects will increase for E.ON. The competitiveness of photovoltaic projects could depend on good schedules, and this project provides a good basis for further developments.

To sum up, a scalable solution has been achieved for the day-ahead scheduling of Szigetvár gamma which already produces extra profit for the company. The project has high potential to enhance profitability of future photovoltaic projects, and the solution is prepared to get tested with other power plants of the company.