SkyFoundry CASE STUDY

From Crisis to Savings: Using Machine Learning to Verify Cost Savings Achieved With Energy Conservation Measures (ECMs)

Introduction

This case study is based on data from Lehotsky Capital's portfolio. Lehotsky Capital provides a broad range of services in the energy sector and operates mostly in the Czech Republic and Slovakia. The desire for energy conservation has always been important; however, the COVID-19 pandemic aftermath, environmental effects, and the ongoing conflict in the Ukraine created an energy crisis for the Czech Republic in 2022 elevating the need and urgency for reductions in energy consumption. The uncertainty of the market motivated energy professionals to increase their efforts to address energy costs and possible savings. With an installed capacity of 230 MW of heat sources and 243 energy sources, Lehotsky Capital supplies energy to over 55,000 residents. The primary objective of this study is to quantify potential energy savings and reduce operating costs, ultimately leading to cost savings. The savings evaluation was conducted on a subset of the total portfolio of the heat meters with sufficient data to support the analysis.

Energy Cost Saving Measures (ECMs) Proposal

With the aim of developing energy conservation measures, the team took several actions in the winter of 2022, including: (i) monitoring heating circuits and hot water systems using SkySpark®; (ii) revising and optimizing heating

Figure 1: Overview of applied rules.

curves and schedules by utilizing dozens of HVAC rules within SkySpark; and (iii) a complete review and overhaul of the legionella prevention measures focusing on correct temperature setpoints and measure duration—heating to unnecessarily high temperatures for hours instead of minutes. These measures resulted in significant energy savings for the building portfolio. SkySpark provided a quick and efficient way to monitor an extensive portfolio and focus only on the problematic sites (Figure 1).

Achieving Energy Savings

The actual energy consumed was compared against the expected values had the ECMs not been implemented. Without the use of SkySpark, the team would have to spend time daily on tedious manual work—waiting the entire heating season to gauge the results of the ECMs. However, SkySpark provided immediate feedback on the effect of ECMs enabling prompt modifications or adjustments. This dramatically accelerated the teams efforts to zero in on the proper ECMs.

To establish a baseline value comparing the actual, the Energy Twin Interactive (ETi) tool, utilizing data ingested into SkySpark, was used to create and tune the models. The interactive simple-to-use graphical user interface (GUI) of SkySpark allowed for easy identification of outliers. The data point excluded from the model's baseline is represented as a red point on the graph and was removed from the model. (Figure 2)

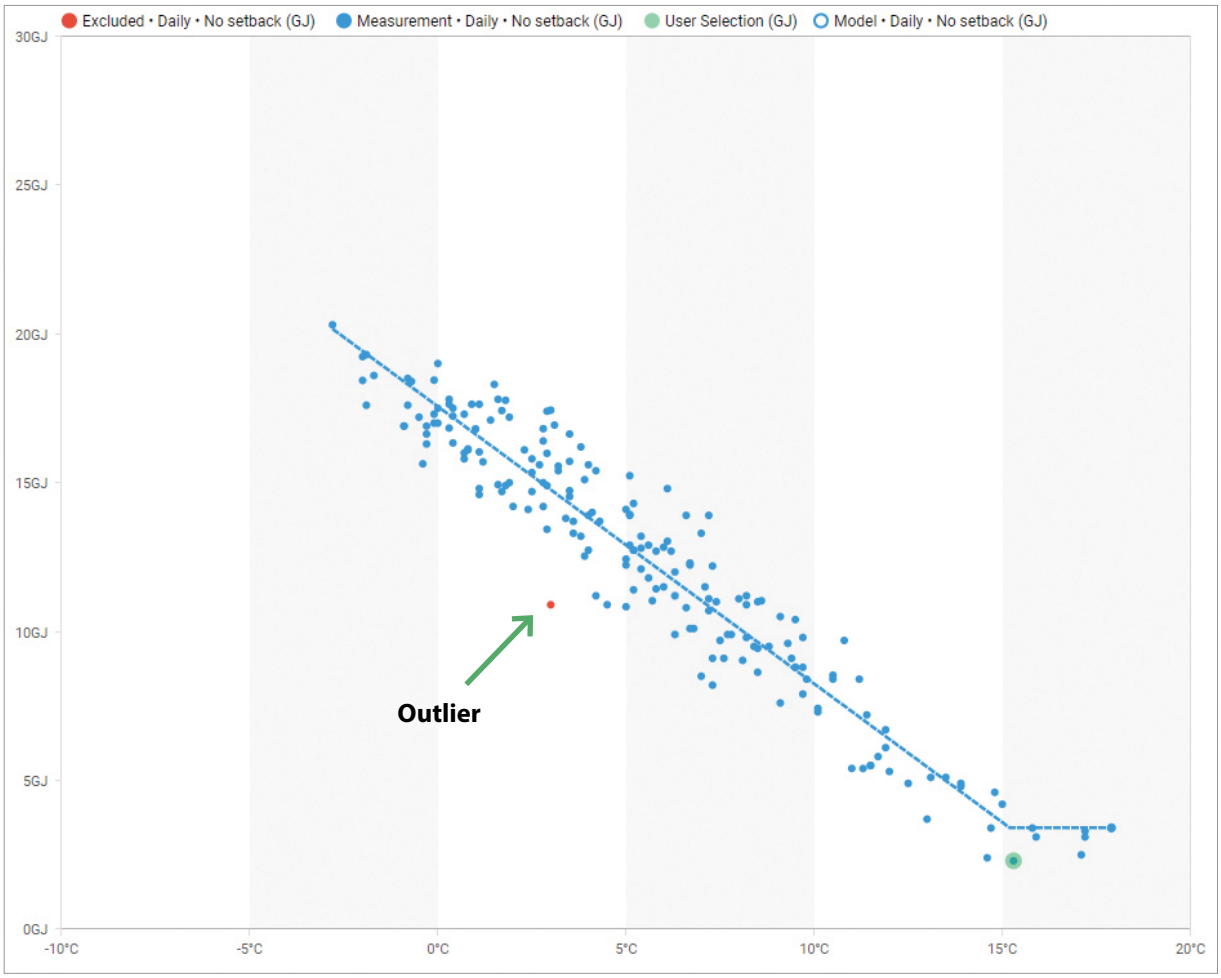
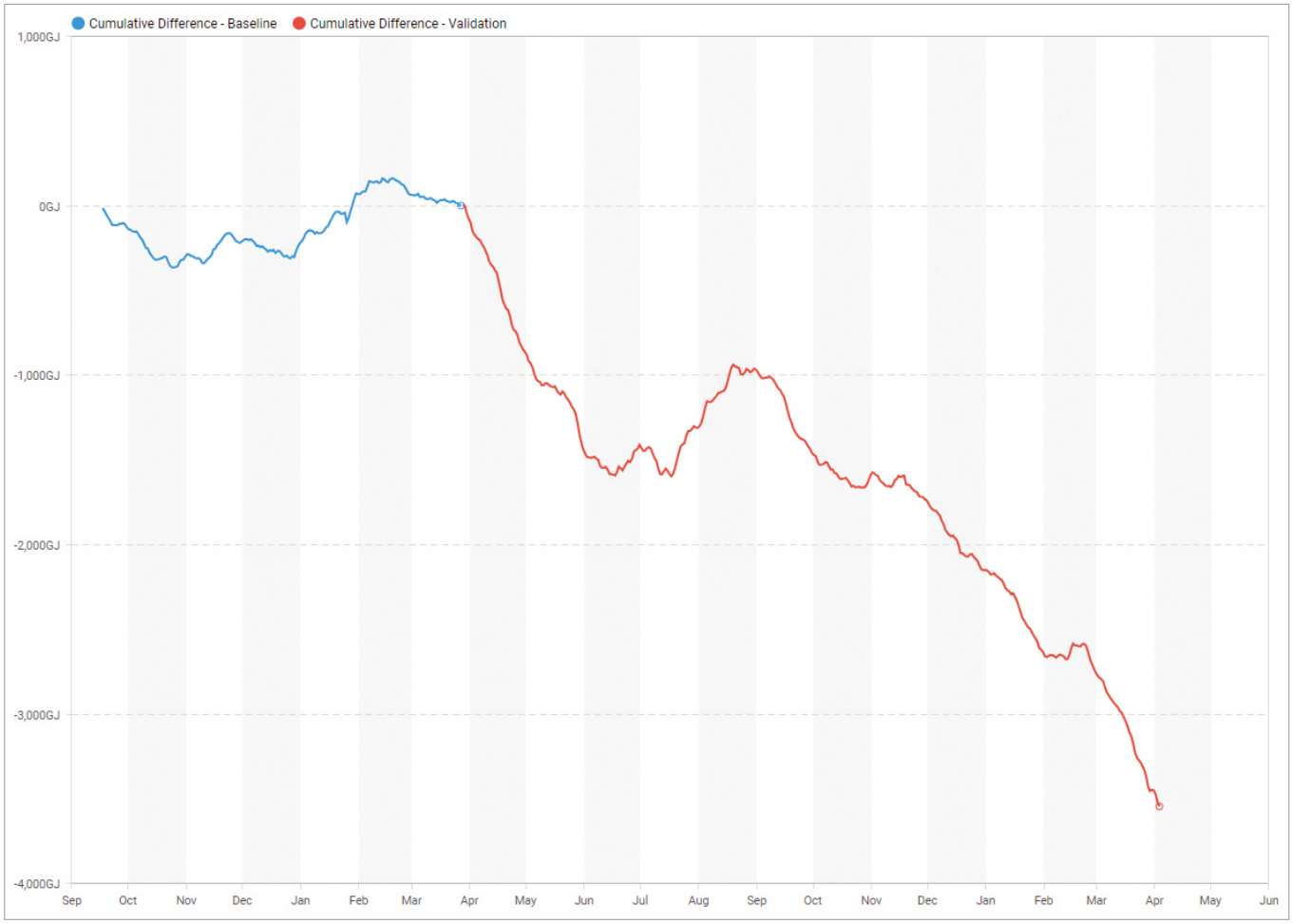


Figure 2: Model identification in ETi including outlier removal.

This way, data points removed from the identification period can be easily double-checked. For accuracy, models were created and refined for each site separately. The same baseline period was used for training for all models, from September 17, 2021, to March 27, 2022. That period was selected to ensure that the models could effectively account for the entire heating season, which was particularly important since heat was being modeled.

Model	Adj. R^2	R^2	NDB	CV(RMSE)	M. Shape	Model Type
Daily • No setback	**0.921**	**0.922**	**0.0%**	**9.81%**	**Good**	**Three Parameter Heating**
Daily • No setback	0.921	0.923	0.0%	9.823%	Good	Four Parameter
Daily • No setback	0.919	0.92	-0.0%	9.929%	Good	Two Parameter
Daily • No setback	0.919	0.92	0.0%	9.929%	Good	HDD model
Daily • No setback	0.919	0.92	-0.0%	9.956%	Bad	HDD and CDD model
Daily • No setback	0.919	0.92	0.0%	9.956%	Bad	Three Parameter Cooling
Daily • No setback	0.917	0.92	0.0%	10.03%	Bad	Five Parameter
Daily • No setback	-0.011	-0.0	0.0%	35.1%	Bad	CDD model

Figure 3: Overview of all possible model types and their statistical properties calculated in ETi.



Metric	Baseline period	Validation period
Measured consumption	28,433GJ	33,012GJ
Predicted consumption	28,432GJ	36,556GJ
Cumulative difference	0.64GJ	-3,544GJ

Figure 4: Cumulative difference in consumption of the whole portfolio. Blue line depicts baseline period used for model identification; red line depicts validation period of energy savings measures.

ETi offers various model types allowing for autotuning, which shows an overview of all possibilities (Figure 3) supported by ETi with their statistical properties and color-coded characteristics according to the measurement and verification (M&V) guidelines (ASHRAE Guideline 14-2014, Measurement of Energy, Demand, and Water savings).

To evaluate the energy savings achieved through the implemented measures, a method that involves comparing the predicted and actual values across the entire portfolio was used (Figure 4). The blue part of the graph shows the baseline period where the cumulative difference approaches zero, indicating that the model's predictions are in line with the actual measurements. If the portfolio is managed well, the cumulative difference will go into negatives when used during the validation period, indicating improved performance compared to the past. In the validation period, represented by the red line, we see a decreasing trend in the cumulative difference achieving an increase in energy savings. Between August and November of 2022, the savings impact declined. However, the energy savings trend resumed resulting in savings of 3544 GJ from March 2022 through April 2023. These savings were particularly appreciated considering that the unit price had almost doubled from the previous year to 57.6$ per GJ. The ECMs delivered energy savings of $204,000 USD across the entire portfolio amounting to a 9.7% reduction in energy consumption.

Conclusion

In conclusion, the case study demonstrates the potential of energy-saving measures to achieve significant cost savings and reduction of energy consumption, even in challenging market environments. Immediate impact evaluation tools, such as Energy Twin Interactive and SkySpark, can enhance the efficiency of implementing such measures. These tools provide prompt feedback for fine-tuning and adjusting measures, while automating mundane tasks, thus reducing the workload of energy experts.

Lehotsky Capital's efforts to monitor heating circuits, optimize heating schedules and setpoints, and improve legionella prevention methods achieved annualized energy savings of 9.7%. The findings of this study have important implications for energy professionals seeking to **reduce operating costs** and **improve energy efficiency** in their portfolios.

Energy Twin®

Energy Twin Machine Learning Extension for SkySpark

The Energy Twin team is a SkyFoundry partner based in the Czech Republic. They have deep expertise in Machine Learning and other advanced AI techniques for energy analysis and fault detection. For more information, contact the Energy Twin team at **https://energytwin.io/**

Lehotsky CAPITAL

Lehotsky Capital

Lehotsky Capital is a company dealing with complex services in the field of energy. We focus on activities and products associated with the introduction of new trends and technologies within the energy segment. For more information visit their website at **https://lehotskycapital.com/**

SkySpark® – Analytics for a World of Smart Device Data

The past decade has seen dramatic advances in automation systems and smart devices. From IP connected systems using a variety of standard protocols, to support for web services and xml data schemas, it is now possible to get the data produced by the wide range of devices found in today's buildings and equipment systems.

Access to this data opens up new opportunities for the creation of value-added services to help businesses reduce energy consumption and cost, and to identify opportunities to enhance operations through improved control, and replacement or repair of capital equipment. Access to the data is just the first step in that journey, however. The new challenge is how to manage and derive value from the exploding amount of data available from these smart and connected devices. **SkyFoundry's SkySpark** directly addresses this challenge.

SkyFoundry

About SkyFoundry

SkyFoundry's mission is to provide software solutions for the "Internet of Things". Areas of focus include:

- Building automation and facility management
- Energy management, utility data analytics
- Remote device and equipment monitoring
- Asset management

SkyFoundry's software helps customers derive value from their investments in smart systems. Learn more and request a demonstration at **www.skyfoundry.com**.