Experiments and actions on the pilot projects 2 until 31.12.2024

1. Data Connection, Visualization, and Work Orders

The connection to ISKRA's database was successfully established, allowing for real-time data acquisition for energy usage across production lines and energy producers. Visualization of this data has been in progress, with the main focus on integrating energy data into the digital twin. Discussions focused on gathering and structuring the work orders for the production lines, ensuring the correct format and data structure needed for the digital twin were aligned.

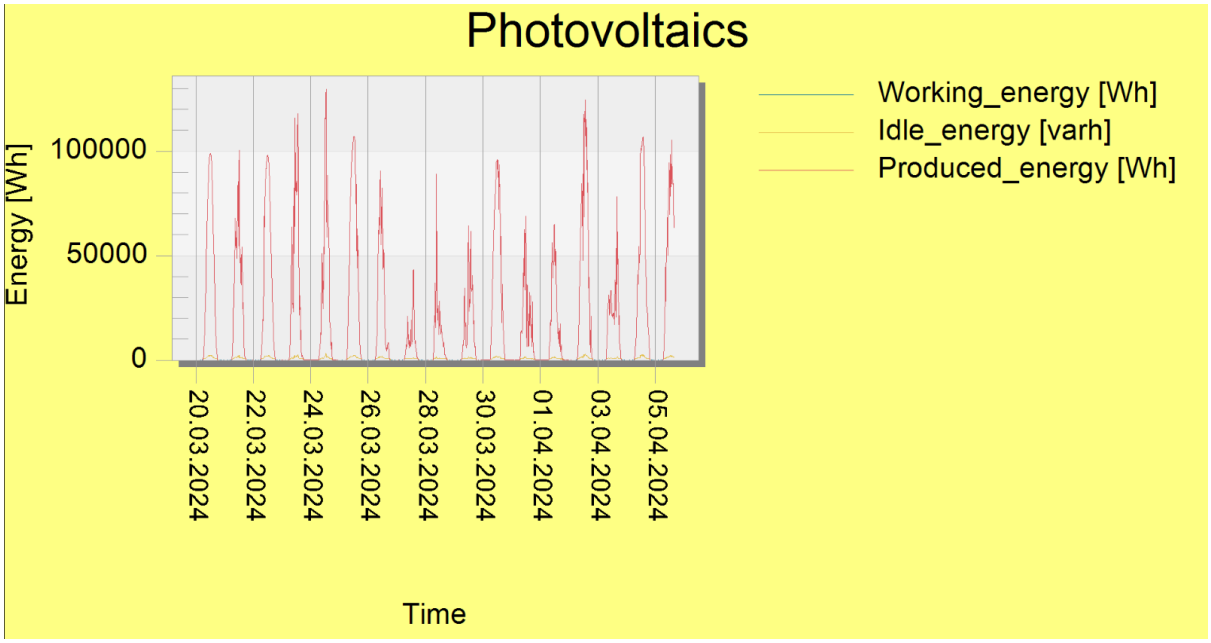

Figure 1: Visualisation of produced energy in Solar factory - Technomatix Plant Simulation.

The data format for work orders was reviewed and agreed upon. ISKRA presented the current work order report, which included the production line, date/time, and quantity of parts produced. It was agreed that ISKRA would extend this data to the other production lines and filter existing data to match the required format for the digital twin.

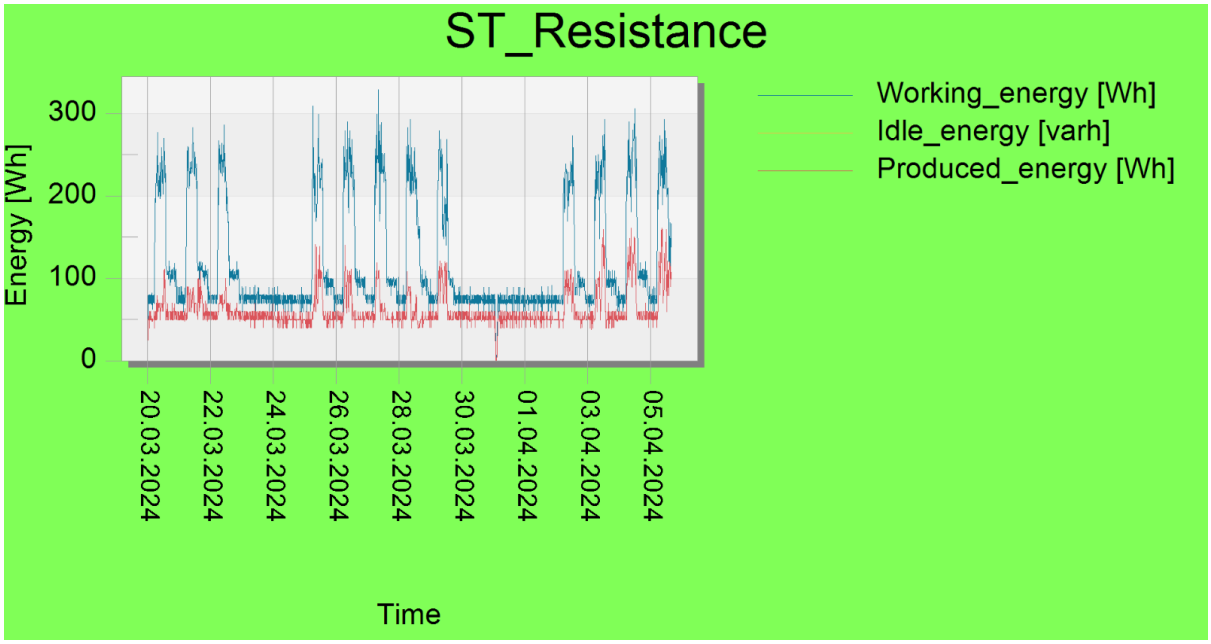

Figure 2: Visualisation of consumed energy in production line - Technomatix Plant Simulation.

2. Anomalies in Energy Data

Anomalies in the energy data, including missing values, abnormal spikes, and missing timestamps were addressed. DIGITEH presented the visualizations of the energy data and pointed out abnormal peaks in the data, which were attributed to missing timestamps. ISKRA explained that these missing data points were likely caused by counter shutdowns, where data was not recorded during these periods.

A discussion followed regarding the implementation of a failsafe system at DIGITEH's end to prevent the digital twin from receiving false data. It was agreed that such anomalies would be handled, and energy peaks caused by missing data would be accounted for.

3. Advances in Digital Model

Significant progress has been made in the development of the digital twin model. New algorithms were created to improve the simulation's performance. Previously, the simulation always started with the first-time stamped data. Now, the algorithm checks for any new data, imports it into the model, and continues the simulation from the previous endpoint, enhancing the efficiency of the simulation.

In parallel, the development of artificial intelligence (AI) and neural networks has started. Several neural networks were evaluated, and an LSTM (Long Short-Term Memory) network was selected for implementation in the simulation model. This addition will enable the digital twin to predict both energy usage and energy production, further enhancing the accuracy and capabilities of the model.

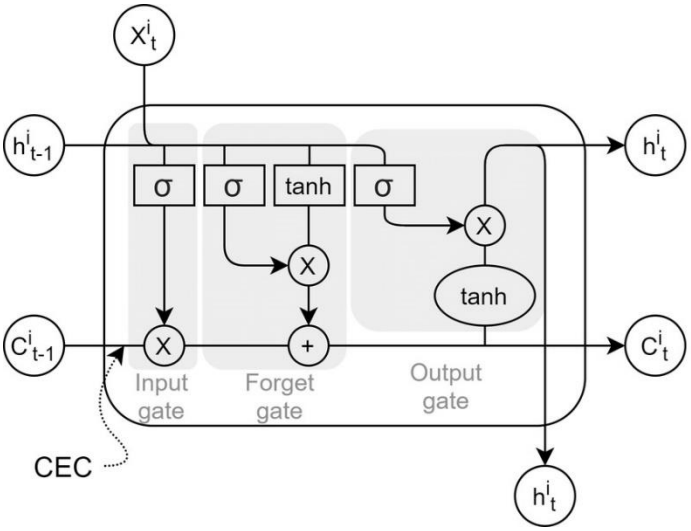

Figure 3: Block diagram - working of LSTM neural network.

Conclusions and Next Steps

Considerable progress in visualizing energy data and addressing data anomalies was made. The work order data has been structured to meet the requirements of the digital twin, and predictive algorithms are being developed to enhance its capabilities. With the integration of AI, particularly the LSTM (Long Short-Term Memory) neural network, the digital twin is set to gain the ability to predict future energy usage and production, improving its performance.

To further advance the project, the following steps are planned:

- DIGITEH will continue working on predictive algorithms based on the available data.
- Simulation algorithms will continue to be refined to improve their performance and adaptability.
- The LSTM neural network will be integrated into the digital twin, enabling predictive capabilities for energy usage and production.
- Management algorithms will be developed to facilitate energy usage and consumption over the whole factory.