Whitepaper

W2E power plant efficiency improvement with DWEEN Waste

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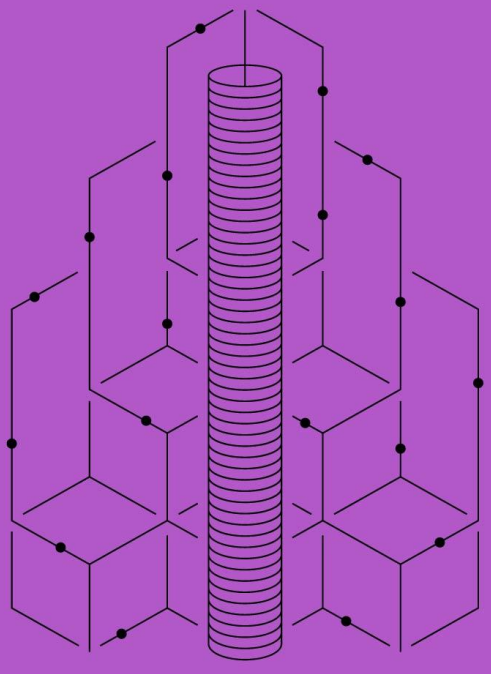
DWEEN Waste



Executive summary

The operative efficiency of a Waste-to-energy power plant depends on many factors, such as the type of waste, its calorific value and the size of the fraction. Traditional control systems do not have the ability to adapt to the constantly changing quality of the waste, so the operator has to constantly adjust the parameters of the combustion process. Holistic management of different Installation systems from different manufacturers is not possible.

Dween Waste software solution controls the Waste-to-energy power plant, ensuring efficient operation of all its components and systems. Higher operating efficiency can be achieved by real-time analysis of the combustion process and continuous adjustment of combustion parameters to the actual fuel used.

No permanent operator supervision is required.

Selectable priorities for controlling the installation are operational efficiency, waste burn rate, heat or power generation.

Company background

Energy Advice is a Technology Development and Advisory company. Our Cloud based Digital Solutions help energy-intensive industries to increase operational efficiency and sustainability.

Our strength is deep knowledge of engineering systems, technologies and processes. We use real time data analysis in our intelligent products to automate and control process flow, improve quality and reduce energy consumption.

Energy Advice is ISO 27001:2013 and ISO 14001:2015 certified.

System functionality

- Intelligent Automatic Control of the combustion process by Artificial Intelligence in ¼ minute intervals:
    - Primary air volume control,
    - Primary air distribution zone control (additional function if automatic dampers are installed),
    - Secondary air volume control and oxygen level in the flue gas,
    - Flue gas recirculation volume control,
    - Flue gas distribution control and recirculation to areas above/below the fuel layer,
    - Grate movement speed control,
    - Fuel dosing control based on energy demand and fuel quality,
    - Pressure in furnace control,
    - Sudden or modest increase or decrease in boiler(s) output based on actual energy demand.
- Real-time comprehensive assessment of waste-to-energy power plant operation:
    - Efficiency of heat exchange between flue gas and thermal fluid (steam): superheater, boiler, dry economiser, flue gas condenser, other heat exchangers,
    - Prediction of carbon monoxide (CO) emissions and corrective actions,
    - Recommendation for ammonia water dosing to ensure acceptable NOx levels and reduce ammonia corrosion,
    - Assesment of sleeve filters condition,
    - Assessment of lime (CaO) dosing,
- Reports, data visualisation:
    - Daily production of thermal energy, MWh,
    - Daily waste consumption, t,
    - Cost of energy production, Eur/MWh & Eur/toe,
    - Electricity consumption kWh/MWh thermal,
    - Cost of produced thermal energy, toe/MWh thermal,
    - Tonnes of waste/MWh thermal,
    - Actual calorific value of the fuel, MJ/kg, and its moisture content, %.

- Predictive Maintenance Tasks:
    - Assessment of the condition of the smoke exhaust fan motor and bearings,
    - Assessment of the condition of turbine bearings based on heat generation and vibration.
- Notifications of deviations from normal operation and deterioration of heat exchange by email and SMS.

Scope of service

- Waste-to-energy power plant and technological process system inventory, data collection and digitisation,
- Waste accounting log:
    - Quantity of waste received,
    - Consumption during the selected period.
- Data retrieval from SCADA, metering devices and other databases at ¼ minute intervals,
- Integration of different IT systems: distributed control systems, crane weighing, fuel scales, electricity and heat plans, shift scheduling,
- Digital twin (mathematical model) of the waste-to-energy power plant, including mass and energy balance in real time,
- Real-time comprehensive assessment of the performance of waste-to-energy power plant,
- Intelligent Automatic Control of the waste-to-energy power plant according to the preselected priority scenario:
    - operational efficiency,
    - waste burn rate,
    - heat or power generation.

Outcome / Benefits

- **Increased efficiency of the waste-to-energy power plant / reduced waste consumption,**
- **Increased electricity production,**
- Intelligent Automatic Control of the combustion process:
    - Reduced involvement of the operator,
    - Reduced risk of tar formation on furnace and boiler,
    - Reduced risk of ash fouling of the furnace,
    - Reduced risk of ash melting,
    - Reduced risk of erosion of the boiler,
    - Reduced risk of corrosion of the boiler.
- Elimination of the risk of human error and increased safety,
- Extended equipment lifetime,
- Reduced ash volume,
- KPI monitoring 24 hours a day, 7 days a week,
- Data archive - information about the waste-to-energy power plant equipment and process is stored in the Dween Waste system for 1 year,
- Reduced maintenance and repair costs due to data-driven decisions,
- Maintenance planning based on data analysis,
- Easier training of new employees,
- Reduction of CO_2 emission.

Assessment of current operation

The project's ROI was estimated based on the operation data received for the period from January 2022 to July 2024. The KPI is calculated as the ratio of electricity produced in MWh to fuel burned in tons. KPI for the whole period is depicted in Chart 1, maximum KPI from historical data is 0.62MWhe/t:

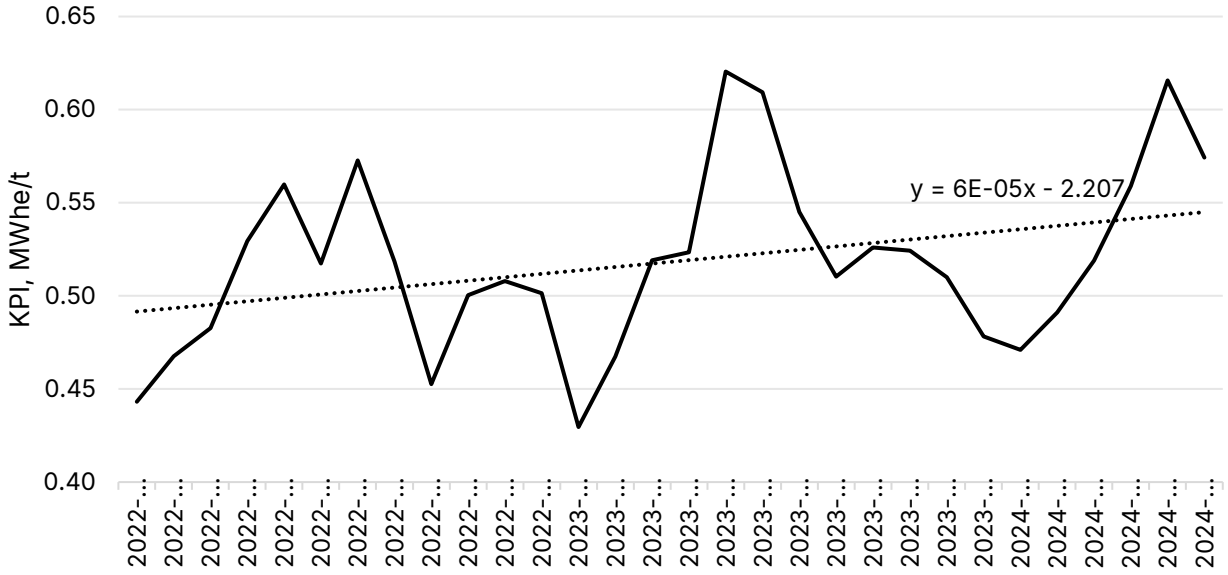


Chart 1 - Ratio of electricity produced to fuel burned

Higher KPI means lower fuel consumption per MWh of electricity produced. Dependence of the KPI on the average monthly electricity production capacity is depicted in Chart 2. Average monthly electricity production capacity was 15.7 MW.

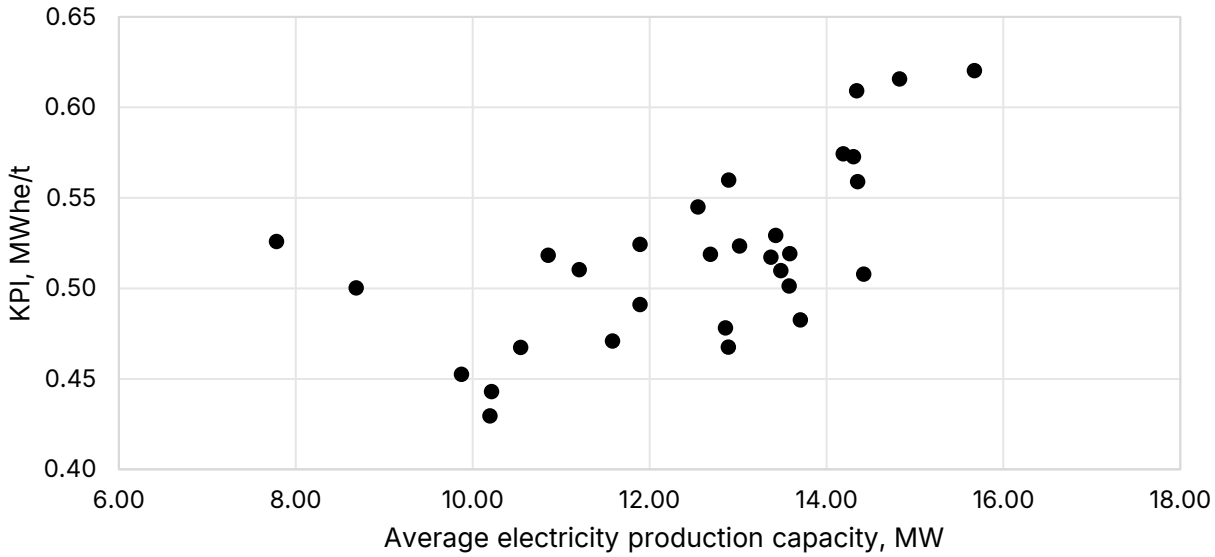


Chart 2 - KPI dependency over monthly average electricity production capacity

Fuel calorific value was calculated as ratio of produced energy in boiler MWh divided by consumed fuel in tons. Chart 3 depicts month with maximum heat production capacity. Average fuel calorific value is 1.5 MWh/t. Months when district heat energy was not produced at maximum capacity were excluded.

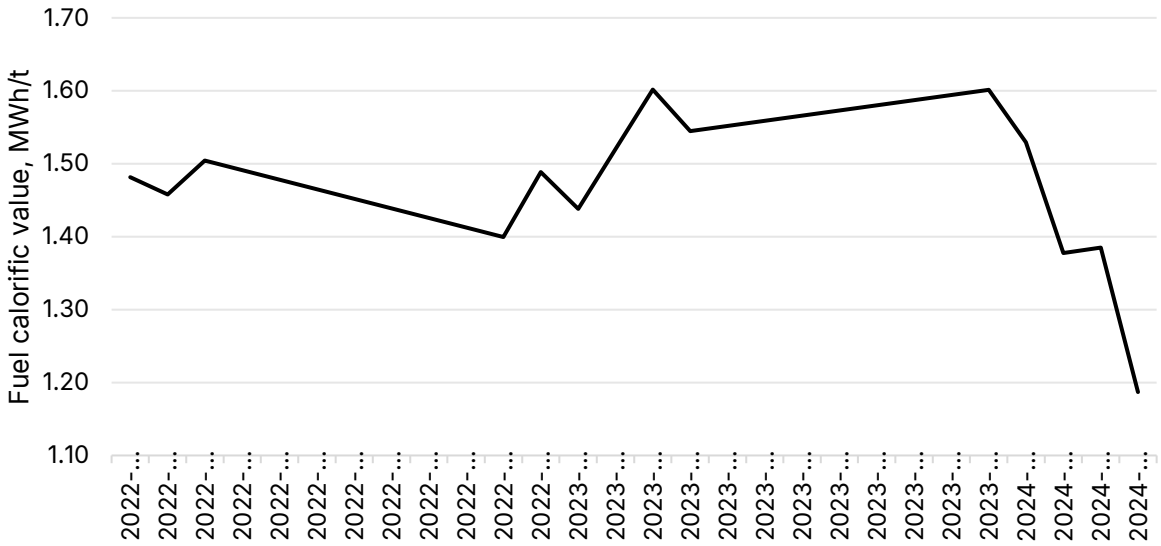


Chart 3 - Fuel calorific value, MWh/t

Projected improvement of operation

Assuming that the quality of the boiler automation allows a better control of the boiler and a maximum KPI of 0.62 MWh/t is reachable, but the fuel supply can be limited, the target capacity was calculated and is shown in Charts 4, 5, 6.

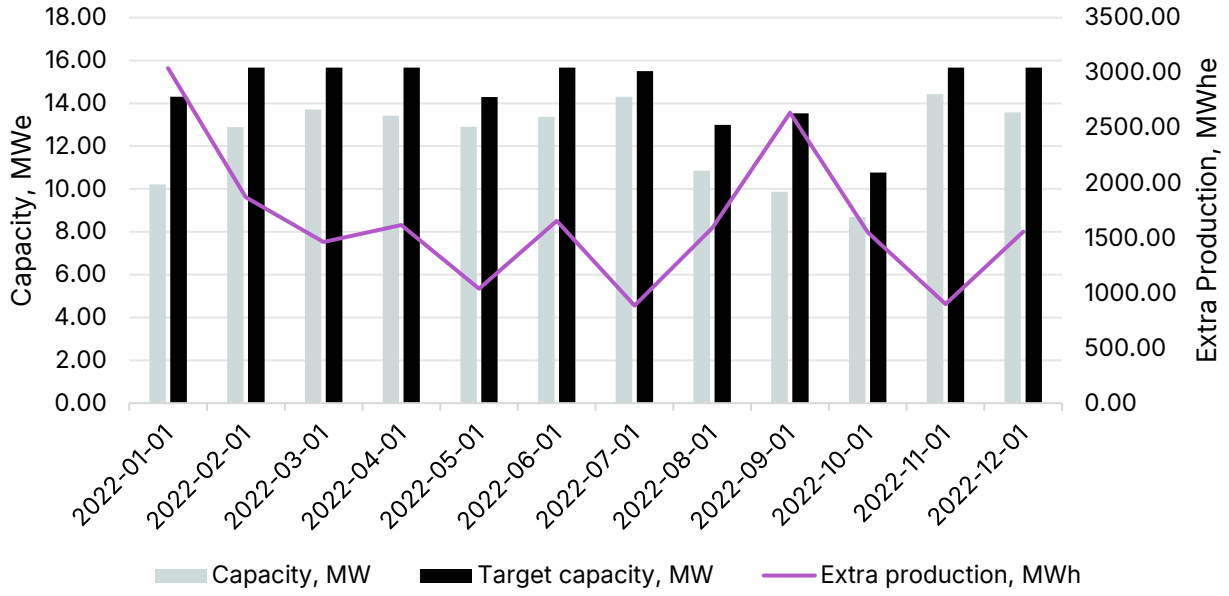


Chart 4 – Target operation capacity and estimated extra production, Y2022

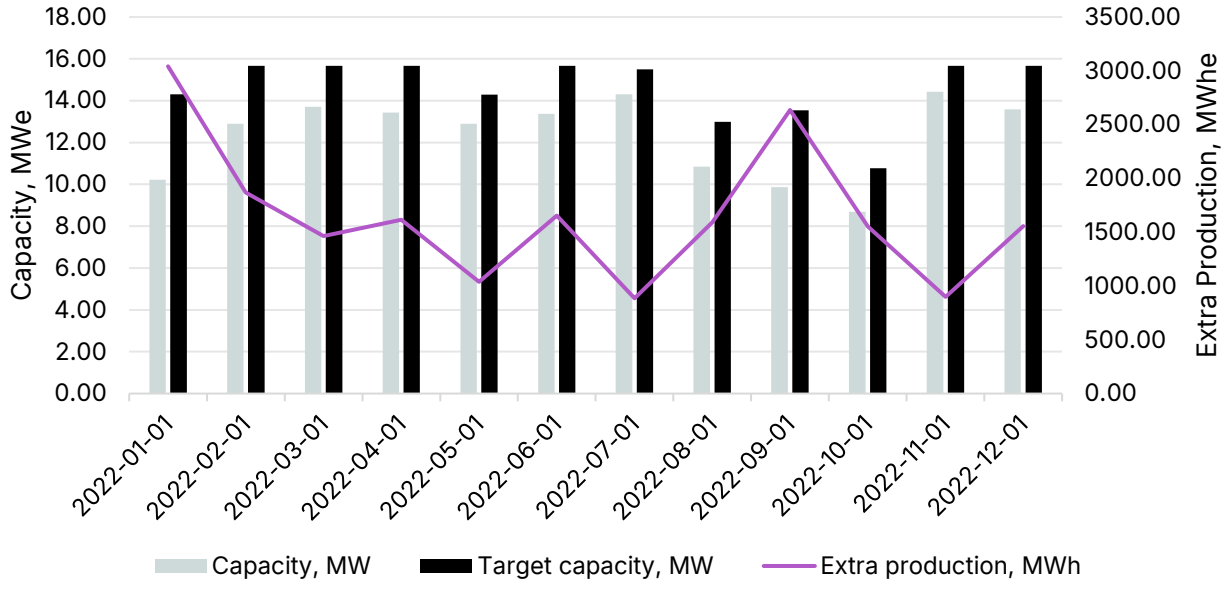


Chart 5 – Target operation capacity and estimated extra production, Y2023

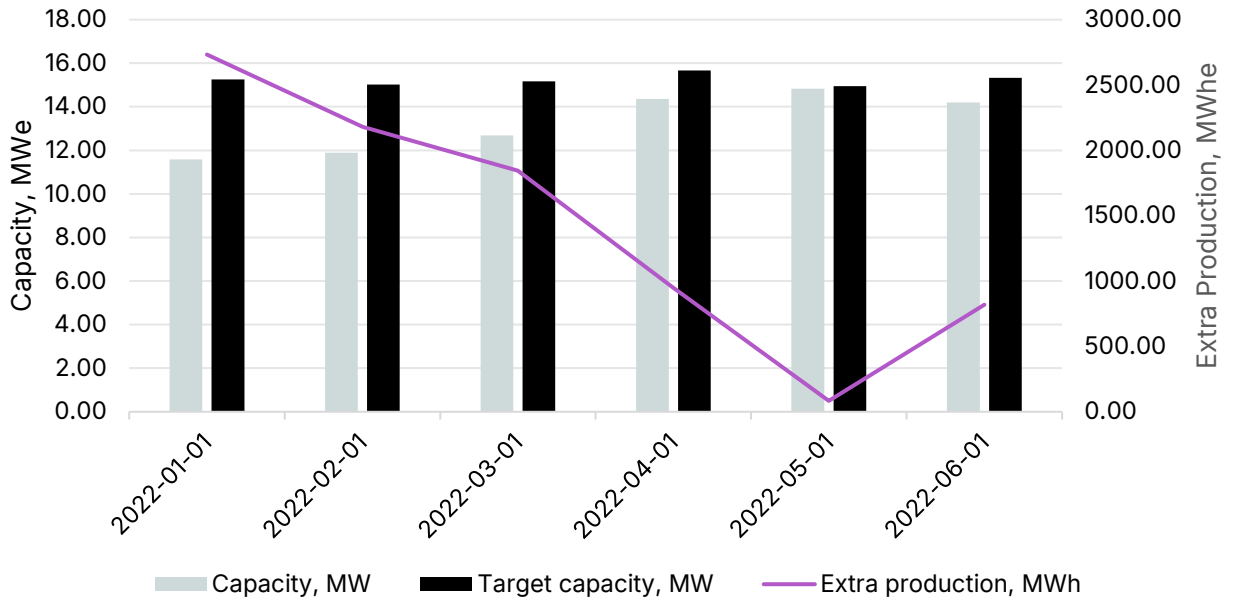


Chart 6 – Target operation capacity and estimated extra production, Y2024

Current electricity production and Estimated Extra production are depicted in Table 5:

Period	Electricity production, MWh	Estimated Extra production, MWh	Estimated increase, %
2022.01-12	108,128	19,800	15.5
2023.01-12	107,535	18,552	14.7
2024.01-06	57,915	8,611	12.9

Table 1 - Electricity production and Extra production due to Intelligent Automatic Control