Whitepaper

BIOMASS POWER PLANT EFFICIENCY IMPROVEMENT

PREPARED BY
Zilvinas Salialionis

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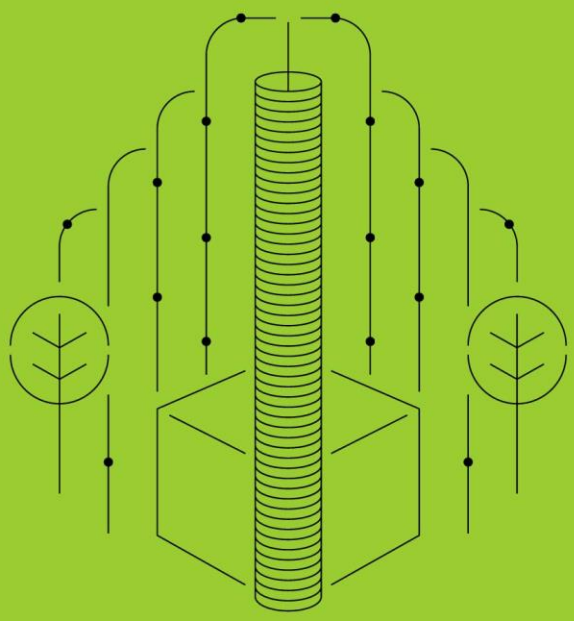
DWEEN Boiler



Executive summary

The operative efficiency of a biofuel power plant depends on many factors, such as the type of biofuel, its moisture or ice content and the size of the fraction. Traditional control systems do not have the ability to adapt to the constantly changing quality of the biofuel, so the operator has to constantly adjust the parameters of the combustion process.

Dween Boiler software solution controls the biofuel power plant, ensuring efficient operation of all its components. Higher operating efficiency and lower biofuel consumption are achieved in real time 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.

The project aim is to improve efficiency of the biofuel power plant.

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.
- Notifications of deviations from normal operation by email and SMS.
- Real-time comprehensive assessment of biofuel power plant efficiency:
    - Boiler(s) efficiency, %,
    - Flue gas condenser efficiency, %,
    - Fuel index, MWh/t.
- Reports, data visualisation:
    - Daily production of thermal energy, MWh,
    - Daily biofuel consumption, MWh & t,
    - Cost of energy production, Eur/MWh & Eur/toe,
    - Electricity consumption kWh/MWh thermal,
    - Cost of produced thermal energy, toe/MWh thermal,
    - Tonnes of biofuel/MWh thermal,
    - Actual calorific value of the fuel, MJ/kg, and its moisture content, %.
- Real-time performance data and control system settings are accessible online.

Scope of the Service

- Biofuel power plant and technological process system inventory, data collection and digitisation,
- Biofuel accounting log:
    - Quantity of biofuel received,
    - Laboratory data for biofuel,
    - Consumption during the selected period.
- Data retrieval from SCADA, metering devices and other databases at ¼ minute intervals,
- Digital twin (mathematical model) of the biofuel power plant, including mass and energy balance in real time,
- Real-time comprehensive assessment of the performance of biofuel power plant,
- Intelligent Automatic Control of the biofuel power plant according to the actual energy demand.

Outcome / Benefits

- Increased efficiency of the biofuel power plant / reduced biofuel consumption,
- 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 boiler(s), related equipment and process is stored in the Dween Boiler 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

Operation charts of biofuel power plant, according to operation and consumption data, provided by customer for Y2023. Production in Flue-gas condenser is excluded:

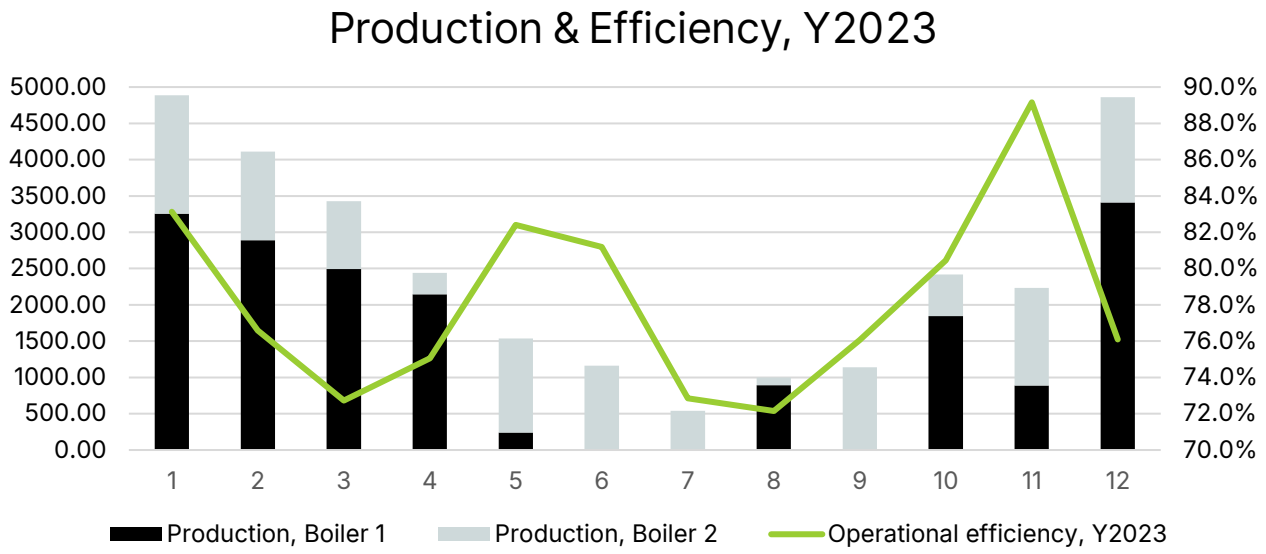


Chart 1 - Production and Operational efficiency, Y2023

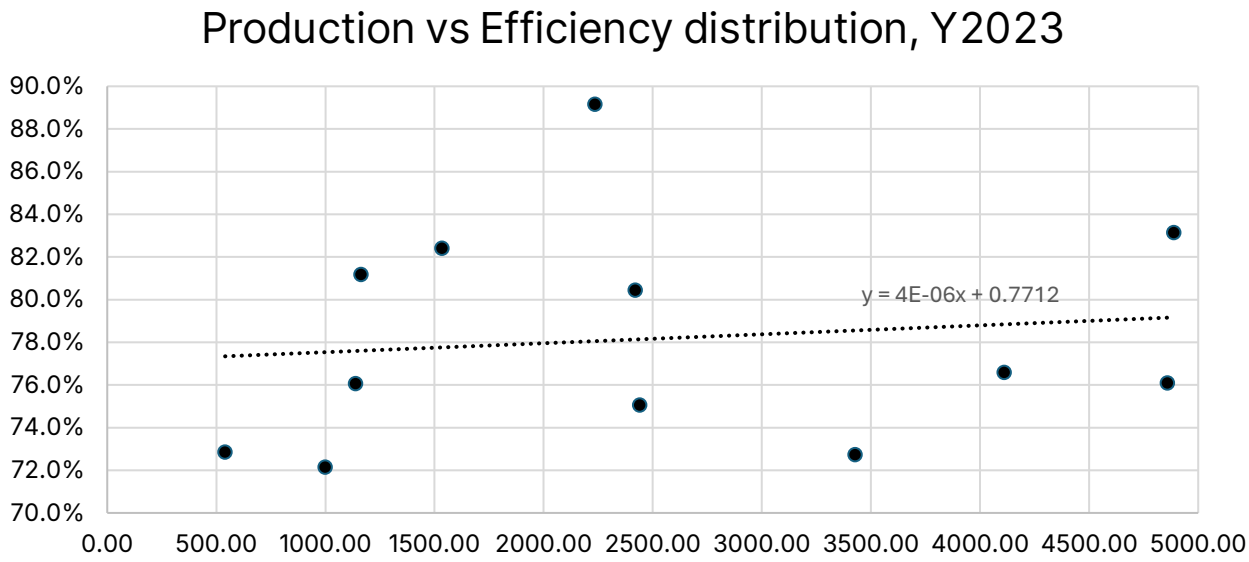


Chart 2 - Production vs Operational efficiency distribution, Y2023

Operation charts of biofuel power plant, according to operation and consumption data, provided by customer for Y2023. Production in Flue-gas condenser is excluded:

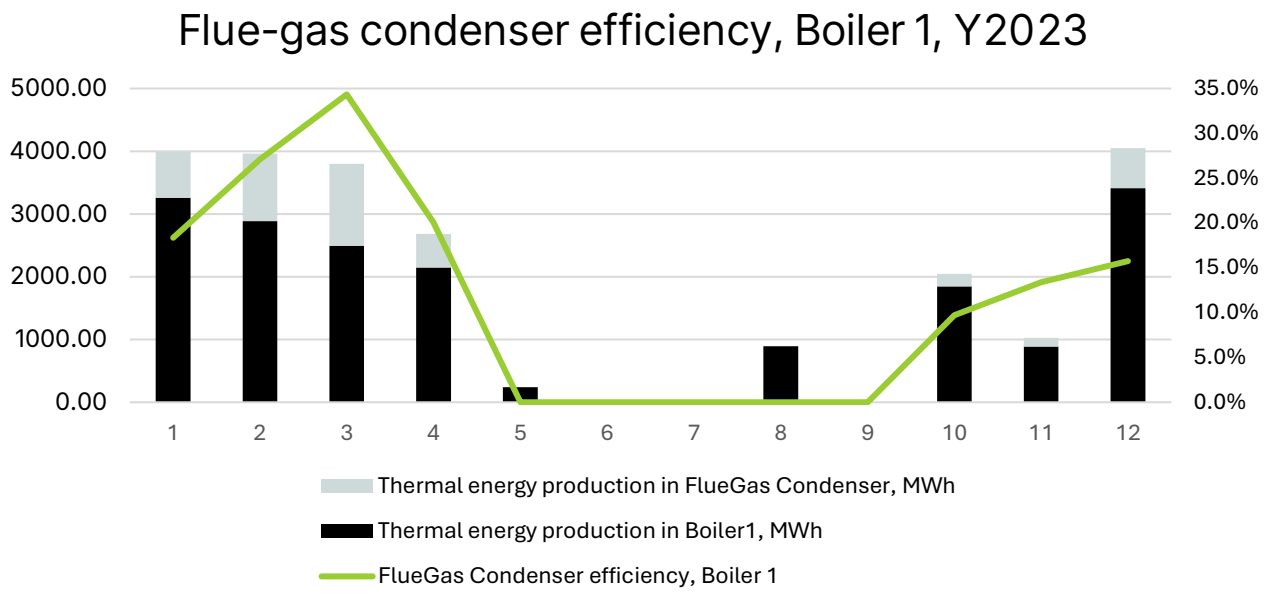


Chart 3 - Flue-gas condenser efficiency, Boiler 1, Y2023

Period	Fuel burned, MWh	Thermal energy produced, MWh	Operational efficiency, %
2023.01-12	38 032	29 758	78.2
2024.01-03	14 951	13 187	88.2

Table 5 - Operational efficiency assessment

Conclusions

Operational efficiency is below expected level, dispersion of consumption vs efficiency is too broad.

It is impossible to evaluate operational efficiency of each boiler individually due to absence of individual fuel accounting.

Efficiency of biomass boiler flue-gas condenser during peak season is below 20% of total biomass boiler production.

Projected improvement of operation

Projected operation charts of biofuel power plant after deploying automated control solution, assuming that MoM production will correspond to Y2023 operation:

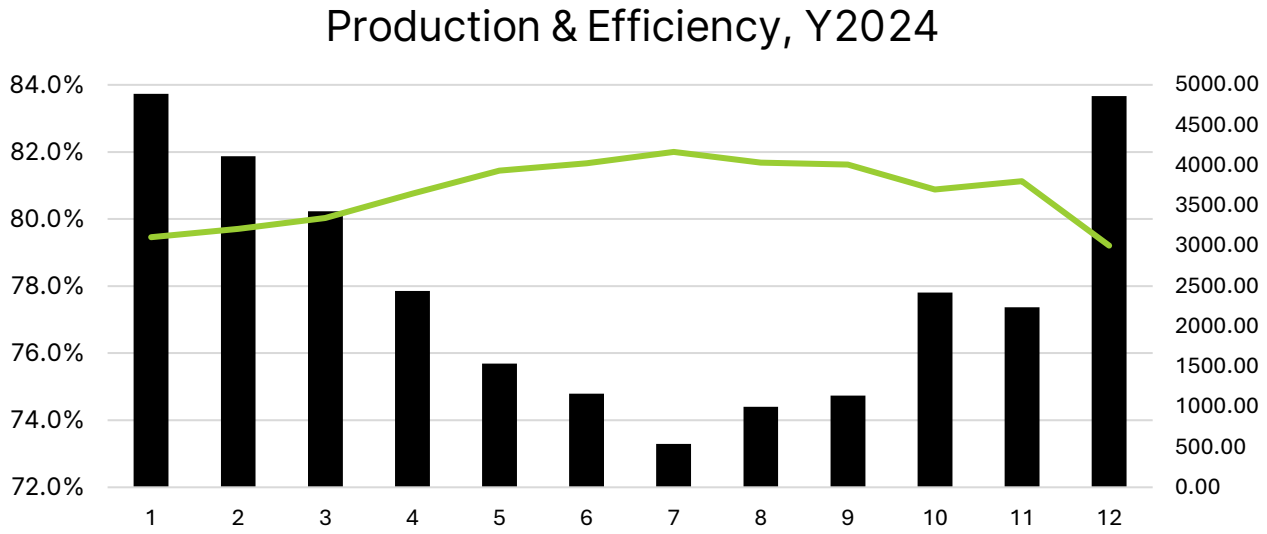


Chart 1 – Projected Production and Operational efficiency, Y2024

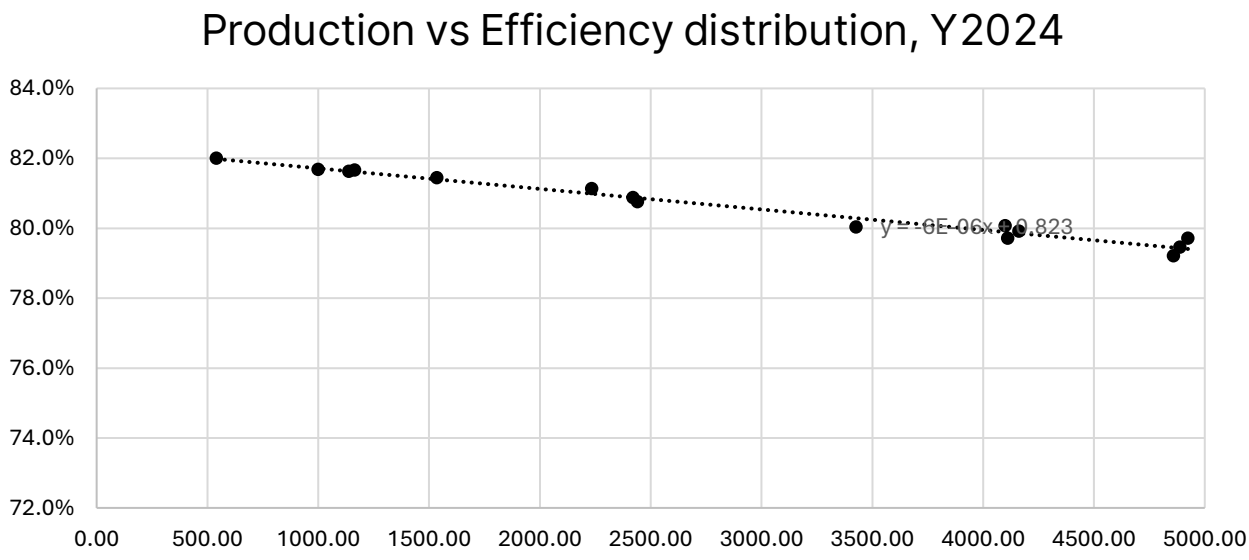


Chart 2 – Projected Production vs Operational efficiency distribution, Y2024

Operational efficiency would be stabilised and the trend in efficiency would be in line with the typical thermodynamic scenario of "lower production, higher efficiency".