

# Boosting the Flexibility of a Combined Cycle Power Plant

No HW retrofit. No new I&C. Just ADEX Self-tuning AI up and running in 2 months

The efforts supporting the energy transition are changing the power generation sector. The increase in penetration of intermittent renewable energy leads to new operating profiles with higher flexibility requirements for fossil power plants.

*“We have increased 60% of our ramping rates, decreased a 24% our Minimum Load Point, and improved our heat rate a 0,17 %, while Temperatures are stabilized and Thermal Stress minimized, thanks to ADEX Technology. That is a real push on Flexibility”*



Mr. Irargorri  
Head of Engineering Project & Planning

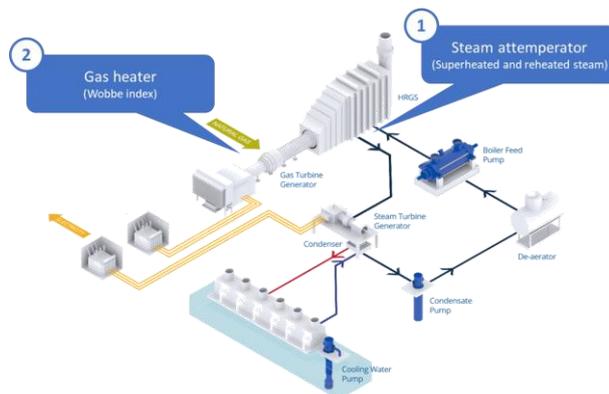
ADEX Self-tuning AI solutions enable thermal power plants to achieve the essential flexibility improvements to become more competitive in the increasingly demanding power generation markets.

Bizkaia Energia is the owner of the Amorebieta 2x1 CCGT generation plant. The plant has a nameplate capacity of 786 MW and consists of two GE MS9001 FA DLN 2.0+ gas turbines and an ALSTOM DKYZZ3-2N41 steam turbine. It is located in the north of Spain.



© photo by Kepa Diez

Bizkaia Energia developed a plan to adapt the operational flexibility and performance that enable them to stay longer in the market or to return earlier.



Amorebieta power plant has been operating in AGC mode, cycling more than 30% of load an average of 150 times per day. In this demanding operating context, the unstable steam temperatures represented a constrain to steepen the plant ramp rate, to decrease the minimum load, and to reduce the thermal stress.

Bizkaia Energia chose ADEX Steam Temperature Optimizers for SH and RH, and ADEX Gas Heater Optimizer to improve the flexibility and performance of the plant.



24% | 65 MW minimum load reduction



60% | 9 MW/min ramp rate increase



7 °C avg. turbine inlet steam increase  
0,17% heat rate improvement



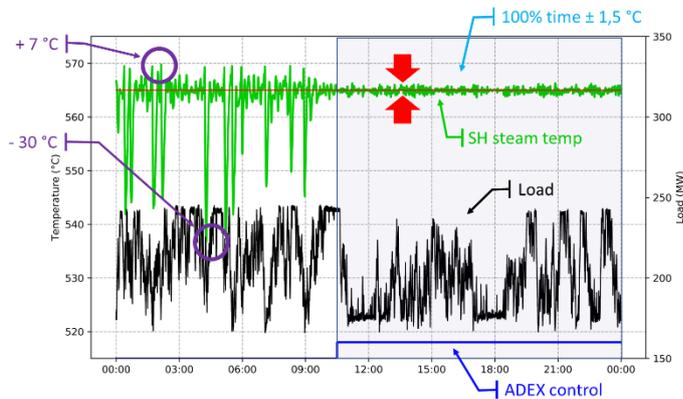
1.200 t CO<sub>2</sub> saved p.a. thanks to the efficiency  
170.000 t CO<sub>2</sub> saved p.a. by the system thanks to the flexibilization increase



Thermal stress reduction and steam turbine lifetime improvement

## Higher performance and lower thermal stress

Bizkaia Energía plant continuously had peaks of +7°C and drops of up to -30°C in SH and RH steam temperature during AGC operation. Ever since ADEX Optimizers for SH and RH were implemented, the temperature is kept  $\pm 1,5^\circ\text{C}$  around the setpoint during 100% of the time, even in AGC operation mode. As a result of the stabilization, the average steam temperature has increased 4,8°C, which implies a heat rate reduction of 0,12%.



ADEX Optimizer eliminates thermal fatigue and overshoot

Thanks to the improvement of the control performance, the plant has taken a step further. ADEX has implemented an optimization setpoint control that increases the steam temperature 2,1°C, reducing the rate an additional 0,05%.

Besides, keeping the temperature in a narrow band leads to a reduction of the induced thermal stress on superheater headers and steam turbines, which increases the equipment life expectancy and the plant availability.

## Enhanced dispatchability. Higher ramp rate and lower minimum load

The main goal of Bizkaia Energía was enhancing its dispatchability by the combination of two factors, a faster ramping load and a reduction on the minimum load of the plant. Bizkaia Energía gas turbines may reduce the minimum load from 270 MW to 205 MW, however, the downstream steam cycle made this operation impossible due to steam attemperators overshoots when ramping down.

After commissioning ADEX Optimizers, the overshoots were eliminated, enabling in 1+1 operation a ramp rate increase from 15 MW/min to 24 MW/min and a minimum load reduction up to 205 MW. These achievements have been possible thanks to ADEX Self-tuning AI keeping the superheated steam temperature within the  $\pm 1,5^\circ\text{C}$  band 100% of the time during any operating condition.

## Combustion challenges

Higher ramp rates and lower minimum loads produce more demanding combustion conditions in the gas turbines. And this is not the only challenge facing BE gas turbines. Once a combustion turbine is tuned to burn a specific gas composition, changes in gas type affect flame stability,  $\text{NO}_x$  formation, and combustion dynamics. With rising LNG imports, the frequency and magnitude of variations in fuel composition have increased, impacting the Wobbe index.

Current technologies are not providing enough accuracy in the gas temperature control, limiting flexibility, and increasing runback risks. ADEX Gas Heater Optimizer controls it 5x more accurately, enabling BE gas turbines to meet the demanding conditions resulting from the flexibility increase and the varying fuel compositions while maintaining flame stability, reducing the dynamics, and eliminating the trip risks.

## Improvements in startups and equipment life

ADEX Steam Temperature Optimizers eliminate temperature excursions and oscillations during the startup. This has enabled BE to operate with the optimal steam temperature setpoint sequence for the steam turbine warm-up. As a result, rotor stress limits are not exceeded, and steam turbine lifetime consumption is reduced.