The case we present concerns reactive energy compensation in a factory producing semi-finished plastic products with a continuous 5/7 work cycle..

The factory is powered by two 15kV/400V transformers. The types of loads are mainly inverters that control new and old generation extrusion motors and other automatic machines. There is a photovoltaic system connected directly to the distribution panel.

The system experienced inadequate reactive power compensation due to the instability of the photovoltaic energy production, which is sized for almost the whole power absorbed by the loads.

Note: PV systems are "variable generators" that may change also drastically the functionality of the electrical system.

There were penalties for capacitive reactive energy consumption, as well as penalties for reactive energy input (existing in some country) during the **F3 night-time period** which is associated with the photovoltaic system and the new LED lighting system. The target was to compensate the reactive energy to ensure a **cosφ close to 1** even in the presence of capacitive load, and to **balance the three phases** affected by imbalance.

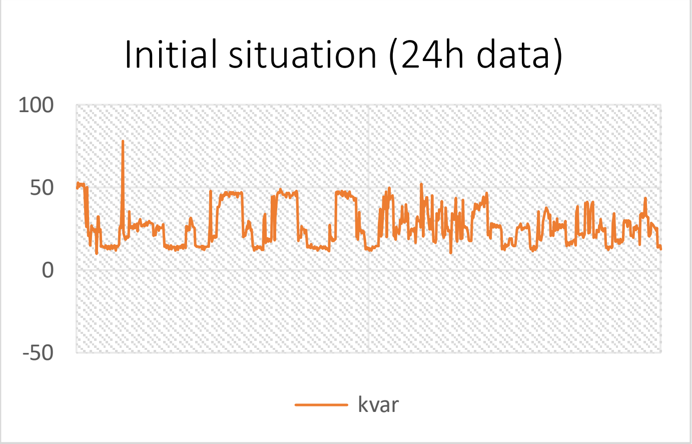
To achieve this result, the existing conventional power factor correction systems were removed and replaced with a hybrid **HSVG-AAR/100** system, consisting of capacitor banks and an electronic power compensator in a three-phase+neutral configuration.

The proposed system is characterised by high compensation speed, in the order of 20 milliseconds, and extreme precision in maintaining the desired cosfi. The hybrid system was the only configuration that allowed real-time compensation of the capacitive cosfi and balancing of the currents on the three phases, in a single machine and smart HMI.

For a complete compensation, a set of three 800A CTs was placed on the input line of the distribution panel, in order to have real-time knowledge of the electrical variables and act in the most effective way on each single phase.

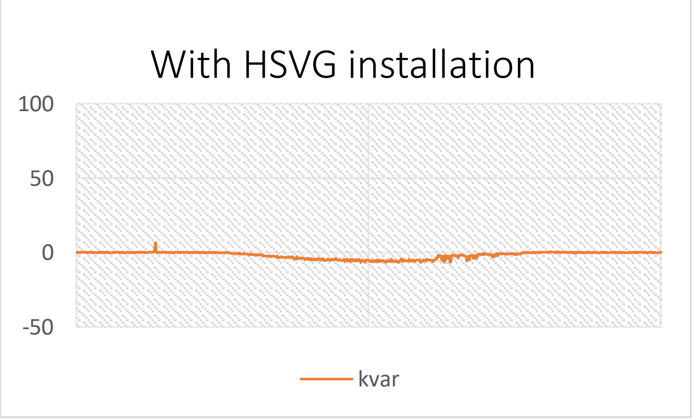
For the sizing of the automatic equipment, we carried out a series of measurements with a network analyser at the main switch..

The system was compensated with a traditional automatic system, consisting of capacitor banks and electromechanical contactors. Measurements taken over a period of one month showed active power consumption with a maximum value of 200 kW, associated with reactive energy consumption, both inductive and capacitive.
The average inductive cosfi value was **0.94** and the average capacitive cosfi value was **0.91**.



As shown in the graph, to achieve the target cosfi≈1, a fast and accurate system is required to compensate for even the slightest fluctuations in the electrical system caused not only by loads but also by the photovoltaic production.

The implementation with the **HSVG hybrid system** resulted in an average inductive and capacitive cos phi of **0.999**, with means a reactive energy consumption close to zero.



In addition to the economic advantage, all the equipment included in the system has benefited from power stabilisation, starting from the upstream MV/LV transformers, which are no longer subject to sudden load fluctuations linked to atmospheric events.

Note: The benefit of a "stabilised" network has significant effects on safeguarding the expected life of active and passive components, with economic relevance that goes well beyond saving on penalties in your bill.