Case Study: Steaming Diesel Engines

You are in a location means that liquid fuel is your only real fuel option, and it's very expensive. A 20 MW power station is required to keep up with increasing electricity demand. The new power station will probably be 4 x 5 MW heavy fuel burning medium speed diesel engines, or possibly 3 x 7 MW units.

Nearby there is food processing company that has high steam demand for cooking and sterilizing. They are burning the same expensive fuel, so any steam that can be raised from the new power station would almost certainly represent an economical cogeneration option.

Great ! Simply put an exhaust gas boiler behind each diesel engine and sell the steam, excellent, no problem and great financial returns compared to the existing steam raising arrangements. There is only one problem, their peak steam demand is about 25% more that can be delivered from the exhaust gas of the diesel engines.

Option 1: Build slightly bigger boilers and install duct firing for extra capacity
This will work and be far more efficient than running traditional boilers to raise the extra steam required.

This solution is simple, practical, efficient and effective, but there may be a more efficient alternative.

Option 2: Utilize the Thermal Energy from the Engine Jacket Water

Can you do this? Well, yes, we identified a prime mover that could operate at elevated temperatures (130C) and a compression system taking low pressure steam from the jacket system and compressing it up to 5 bar for delivery.

This innovative concept allowed the utilization of waste heat that would normally be too low grade for steam production, increasing overall steam production and overall efficiency as a cogeneration option.

A second issue was that the steam demand was driven by batch cooking processes, which by their nature resulted in a very peaky total steam demand analyzing the end use demand, it was determined that the system pressure could be allowed to float or slide. By allowing this, the thermal energy held in the water volume of the boilers could meet the peak demands without having to raise extra steam at those times by firing expensive fuel. Similarly, when steam demand reduced, the large water volume would absorb the available thermal energy, returning the thermal storage to the initial level without dumping steam or wasting thermal energy.

By designing a steam system that allowed sliding pressure and by recovering the thermal energy from the jacket cooling water in the form of steam, the proposed power station could meet 100% of the steam demand required, allowing the existing boiler plant to be laid up indefinitely.