Cogeneration has the potential to increase the efficiency of any power cycle by using the same fuel source to simultaneously produce electricity and heat. This boost in efficiency can prove itself to be a worthwhile investment opportunity, according to a systems thermo-economic structure. By analyzing the exergy use of a system, each component of a system is measured from the same reference state, where changes in exergy correlate to costs of producing, fueling, and operating a power system.

Cogeneration is a process whereby waste heat energy is recycled to provide heat input to another portion of a power cycle. In a Rankine cycle, heat extracted from the turbine has the capacity to heat the working fluid in another portion of the cycle in an effort to increase thermal efficiency. Modern day power-plants operating on a Rankine cycle require that the turbine stage extract as much work as possible out of the thermal fluid (Schmidt et. al, 2006). By optimizing the amount of heat extracted at different stages of the power cycle, the realization is made that power system increases efficiency and minimizes exergy destruction by applying a cogeneration system.

**Used above paragraphs**

It is evidenced in industry that state of the art design and analysis of existing systems has led to development of more efficient technology. Cogenerative systems implemented into existing power-plants take into account various system characteristics. Some generalized parameters include fuel chargeable to electric power, overall system efficiency, electricity per steam flow, minimum process steam required, emission problems, capital costs, gross payback period, unit size and operational lifetime (Hu, 1985). These standards can be critiqued based on cost/benefit analysis as well as technical inspection. Emphasis placed on criteria pertinent to different levels of cogeneration.

Exergy provides a different spectrum for engineers to analyze the efficiency of a power system. To illustrate the ability exergy has to optimize a thermo-economic portfolio, consider the rising cost of conventional fuels consumed by power-plants. The necessity to conserve fuel is a driving factor to implement cogeneration into a power cycle. State of the Art design implemented into a system attempts to optimize the total cost of operation. Advanced technology comes with a high price tag, but the savings in fuel cost from minimizing the irreversibility of heat transfer and exergy destruction create a more efficient operation. State of the art cogeneration components can include *heat-recovery steam generators, heat exchangers turbines, and feedwater heaters.*

No cogeneration exists when thermal energy is generated entirely for use by the cycle, meaning that all electrical power is purchased from a utility company and none is generated from heat. Thermal-match cogeneration produces thermal energy at temperatures and pressures much higher than that required for the power cycle processes. Electric power is generated by the steam at elevated conditions, afterward recovering the steam for use in generating power. The cogeneration system is sized so that thermal energy generated from the system is just enough to meet the demands of the cycle. In Electrical-match cogeneration, thermal energy is again produced at elevated temperatures and pressures, similar to the thermally match case. Electrical power is produced first with the steam, and the recovered steam is then used to power the cycle. The difference in this cogenerative effort is that now the cogeneration system is sized to meet electrical power demands of the cycle. Finally, maximum cogeneration is exists when thermal energy is produced in excess of the cycle. Once electrical power demand is met from producing excess steam, the remainder of steam is dumped to the heat sink, usually the atmosphere. This cogeneration system is sized for maximum economic gain, such as maximum cash flow, or minimal fuel investment (Hu, 1985).