

# Exergetic analysis and evaluation of coal-fired supercritical thermal power plant and natural gas-fired combined cycle power plant

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**Abstract** The present work has been undertaken for energetic and exergetic analysis of coal-fired supercritical thermal power plant and natural gas-fired combined cycle power plant. Comparative analysis has been conducted for the two contestant technologies. The key drivers of energetic and exergetic efficiencies have been studied for each of the major sub-system of two contestant technologies. Overall energetic and exergetic efficiency of coal-fired supercritical thermal power plant are found to be 43.48 and 42.89 %, respectively. Overall energetic and exergetic efficiency of natural gas-fired combined cycle power plant are 54.47 and 53.93 %, respectively. The major energetic power loss has been found in the condenser for coal-fired supercritical thermal power plant. On the other hand, the major energetic power loss has been found in both the condenser and heat recovery steam generator for gas-fired combined cycle thermal power plant. The exergetic analysis shows that boiler field is the main source of exergetic power loss in coal-fired supercritical thermal power plant

and combustion chamber in the gas-fired combined cycle thermal power plant. It is concluded that natural gas-fired combined cycle power plant is better from energetic and exergetic efficiency point of view. These results will be useful to all involved in the improvement of the design of the existing and future power plants.

**Keywords** Thermal power plant · Energetic efficiency · Exergetic efficiency · Supercritical · Heat recovery steam generator

## Abbreviations

B	Boiler
BFP	Boiler feed water pump
C	Air compressor
Con	Condenser
Com	Combustion
CC	Combustion chamber
CEP	Condensate extract pump
D	Deaerator
EXP	Expansion valve
f	Fuel
FWH	Feed water heater
GT	Gas turbine
gen	Generation
heat	High temperature heat exchanger
HPH	High pressure feed water heater
HPT	High pressure turbine
HFP	High pressure feed water pump
HRSG	Heat recovery steam generator
IPT	Intermediate pressure turbine
LPT	Low pressure turbine
LPH	Low pressure feed water heater
LFP	Low pressure feed water pump
p	Combustion products

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