CH1002 Energy Management in Chemical Industries

Unit - VI

Co-Generation

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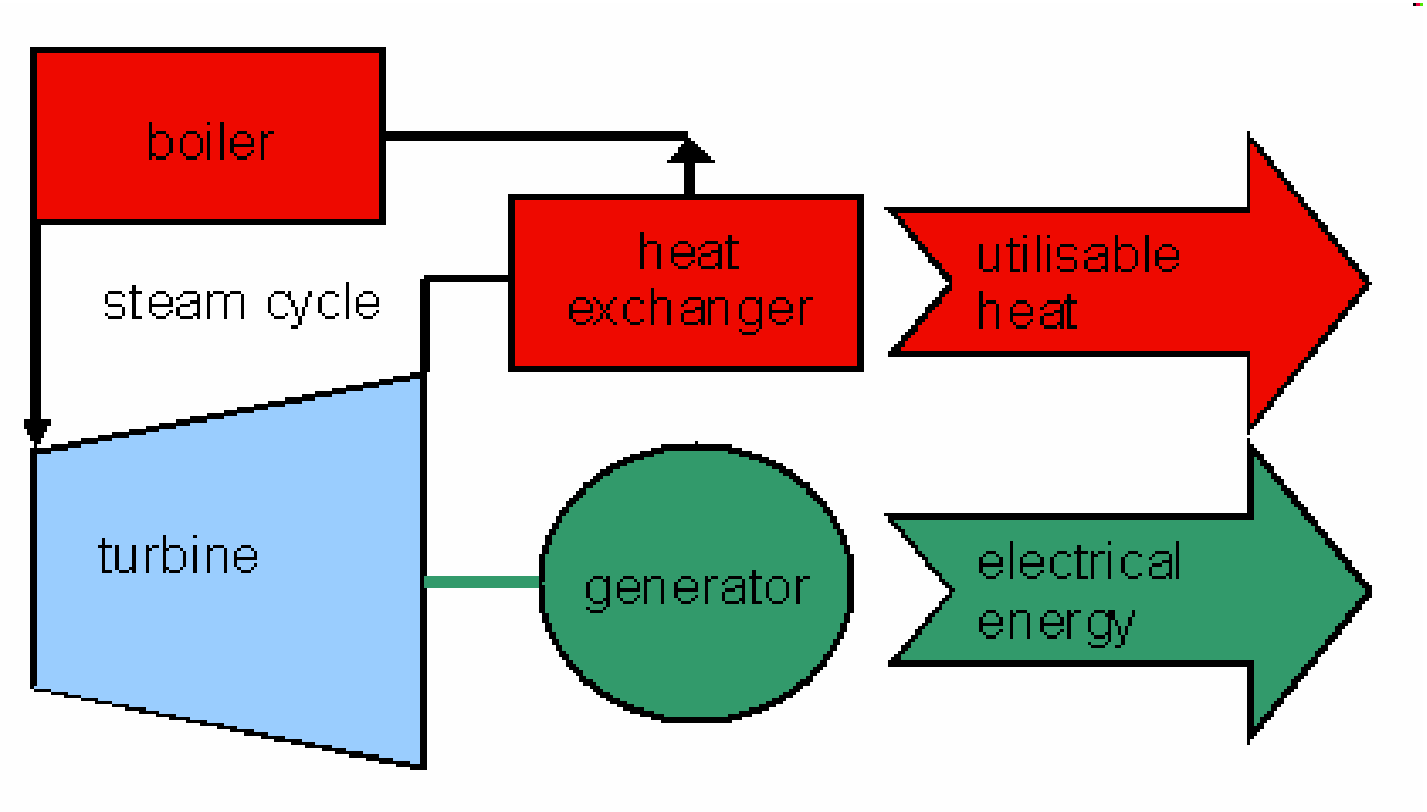
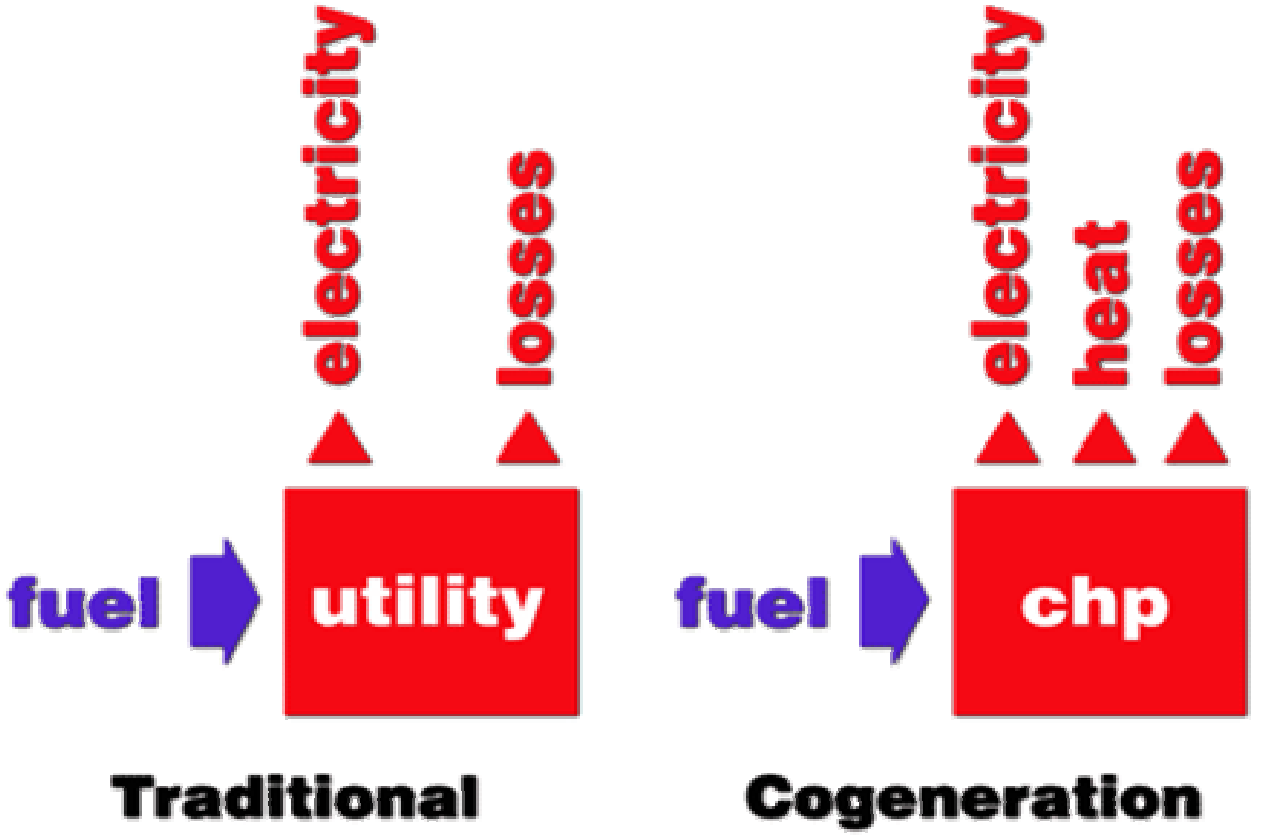

boiler
steam cycle
heat exchanger
utilisable heat
turbine
generator
electrical energy

Cogeneration or CHP

(Combined Heat and Power)



Traditional Power Generation

- Most power generation is based on burning a fuel, predominately coal, although oil or gas are used, producing steam. It is the steam pressure that spins the turbines that drive the generators to create electricity, unfortunately this is inherently an inefficient process.

- No more than approximately one third of the energy potential within original fuel can be converted into steam pressure.

- The traditional generation process feeds our need for power and lighting, yet the process creates vast quantities of heat energy.

- Without a local user, this precious resource has little economic value and is dumped to the atmosphere, using the ubiquitous cooling towers or other convenient techniques.

Co-Generation

- Cogeneration uses the excess heat, usually in the form of relatively low-temperature steam or hot water exhausted from the power generation turbines. Such steam or hot water is suitable for a wide range of heating applications such as building heat, process, air conditioning and domestic hot water provision.

- Therefore effectively displacing the combustion of fossil fuels that would have otherwise been required for these applications, with all the obvious environmental implications.

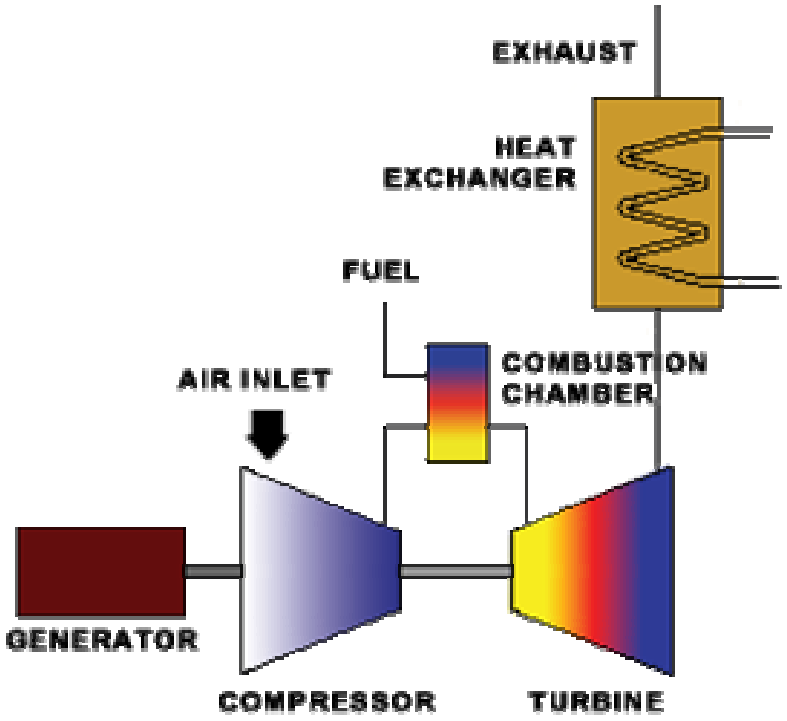
- By displacing fossil fuel combustion with heat that would normally be wasted in the process of power generation, cogeneration reaches efficiencies that triple, or even quadruple, conventional power generation

Co-Generation (contd.)

- The positive environmental implications of cogeneration stem not just from the inherent efficiency, but also from its decentralized character.

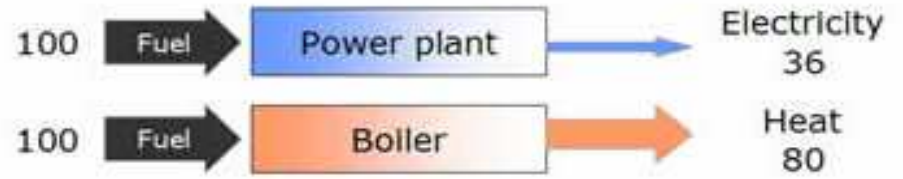
- It is impractical with current technologies to transport heat energy over any distance, therefore cogeneration equipment is physically located close to its heat demand.

- Cogeneration solutions provide a very efficient, 85% or more, local, on-site, power generation system that utilizes waste heat to drive heating, process and even air conditioning requirements.



CONGENERATION SCHEMATIC

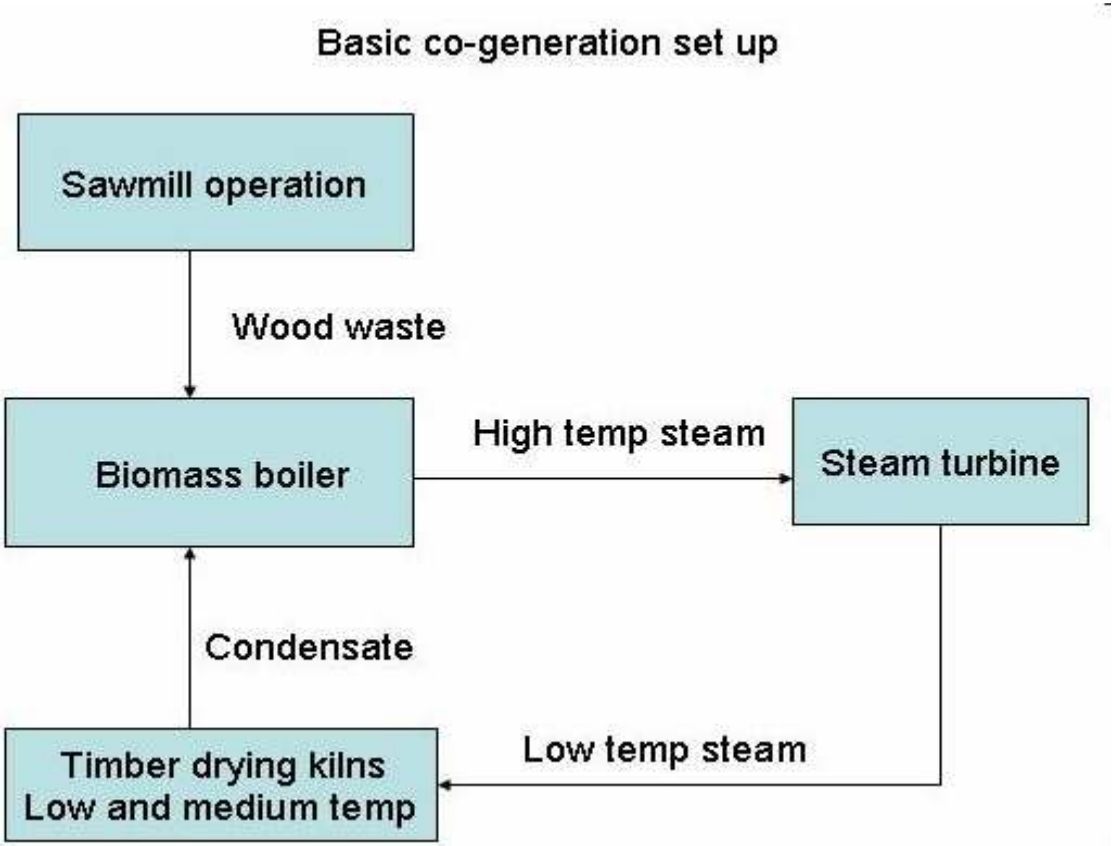
Separate production of electricity and heat



Efficiency: (36+80)/200=0,58 or **58%**

Cogeneration

Efficiency: (30+55)/100=0,85 or **85%**



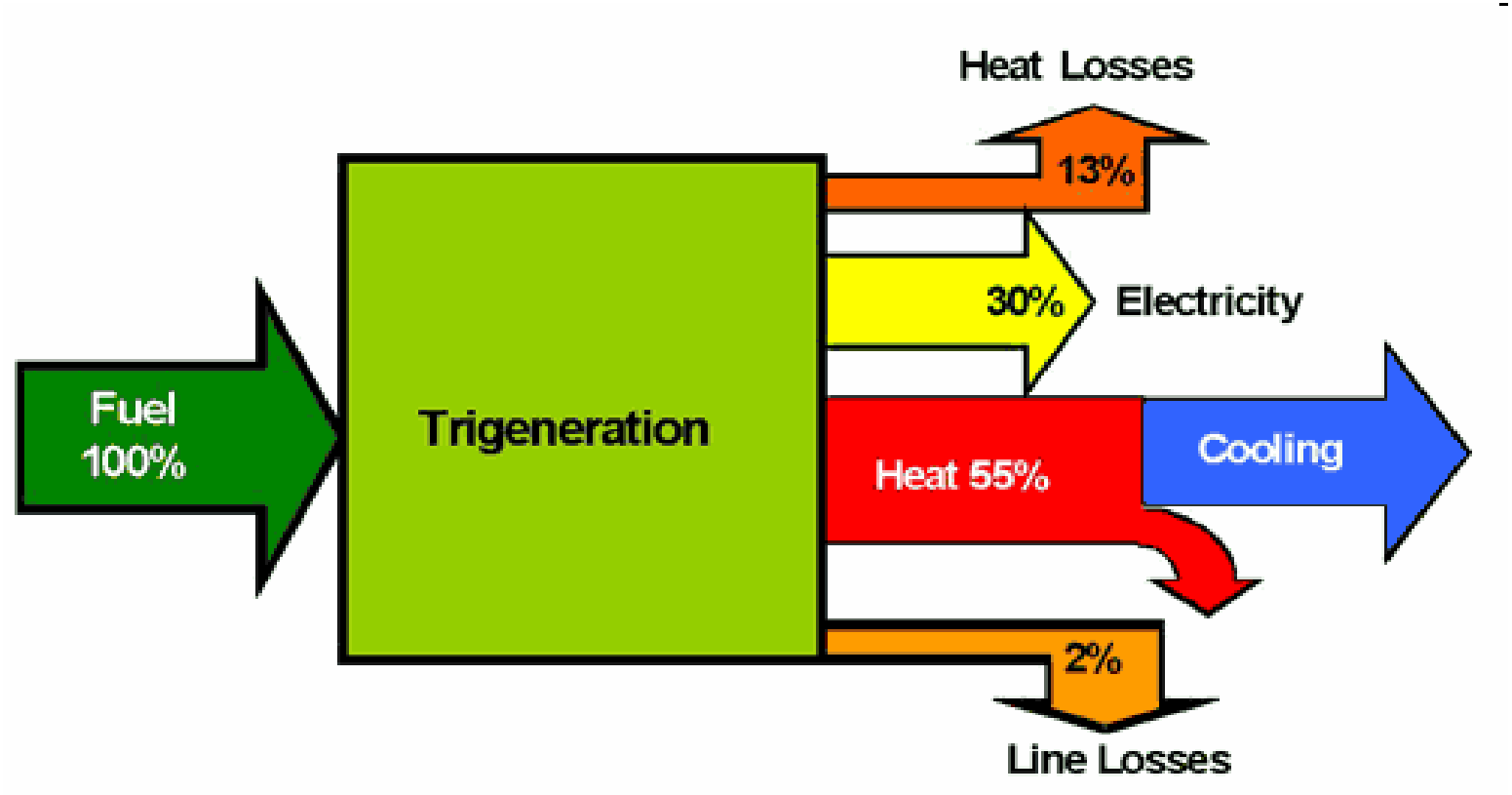
Possible considerations:

- Do I have enough wood waste to supply cogeneration plant?

- Do I have suitable base heat load to make a cogeneration plant economic?

- If I have surplus electricity, am I able to export electricity to the grid and what price can I get for this electricity?

Tri-Generation



Trigeneration power plants' have the highest system efficiencies and are about 300 % more efficient than typical central power plants

Types of Plants

- ***Topping cycle plants*** primarily produce electricity from a steam turbine. The exhausted steam is then condensed, and the low temperature heat released from this condensation is utilized for e.g. district heating.

- ***Bottoming cycle plants*** produce high temperature heat for industrial processes, then a waste heat recovery boiler feeds an electrical plant. Bottoming cycle plants are only used when the industrial process requires very high temperatures, such as furnaces for glass and metal manufacturing, so they are less common.

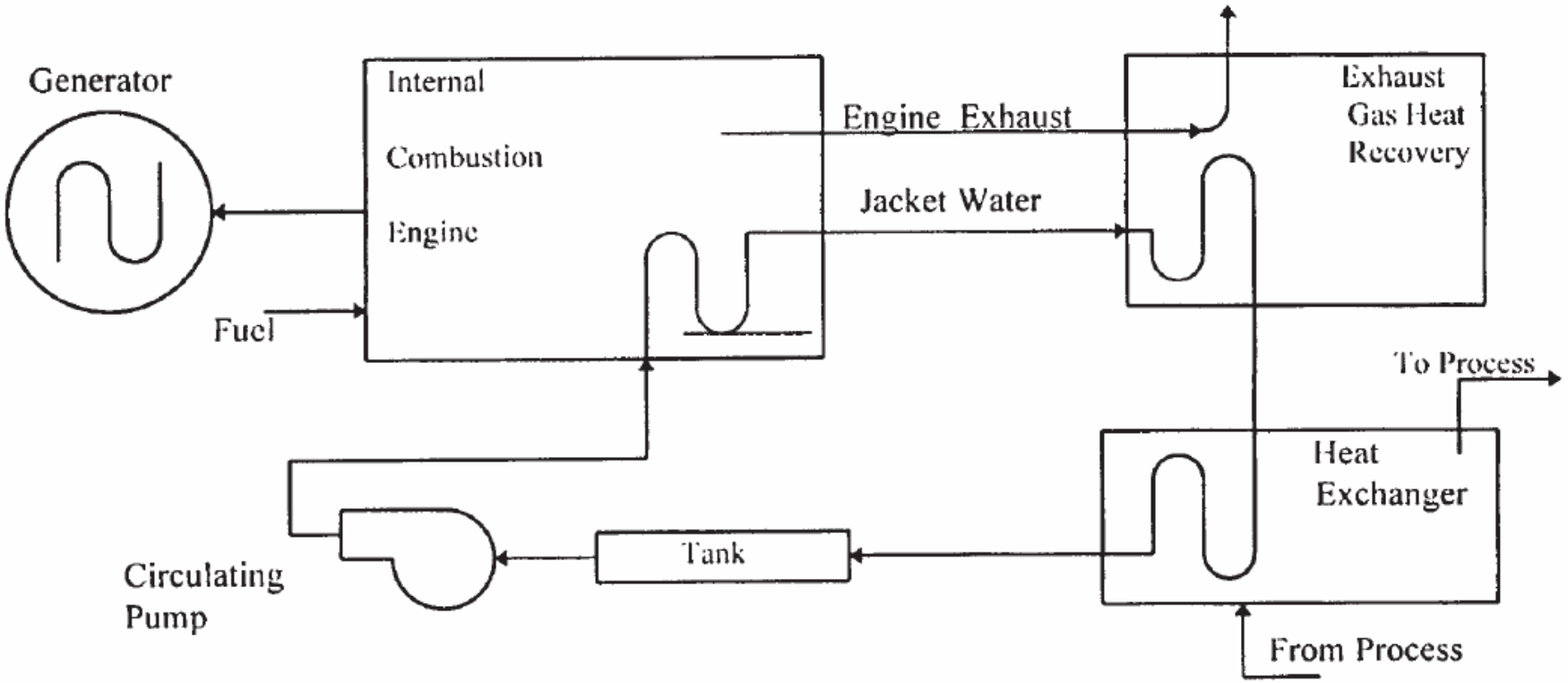


Figure 7.2 Diesel engine topping cycle.

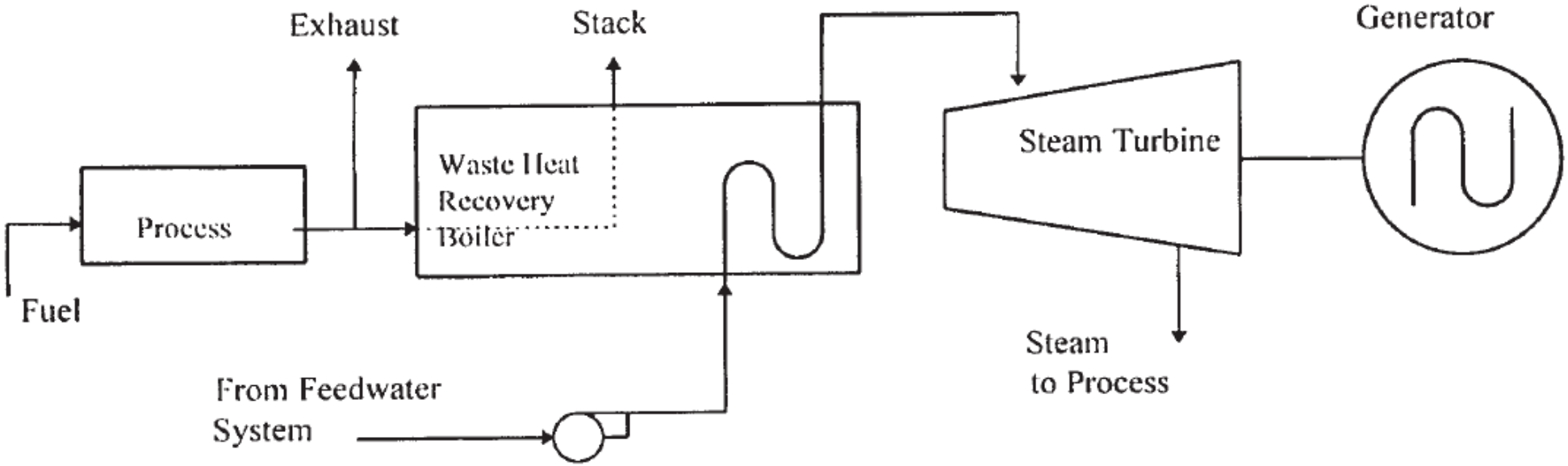


Figure 7.3 Steam turbine bottoming cycle.

Cogeneration Systems

- Most cogeneration systems are based on prime movers such as steam turbines, gas turbines, internal combustion engines and packaged cogeneration.

- Cogeneration can produce a given amount of electricity and processing heat with 30% less fuel than separate production of electricity and processing heat.

- Internal combustion engines are commonly used as prime movers in a small cogeneration cycle, i.e., under 15 MW.