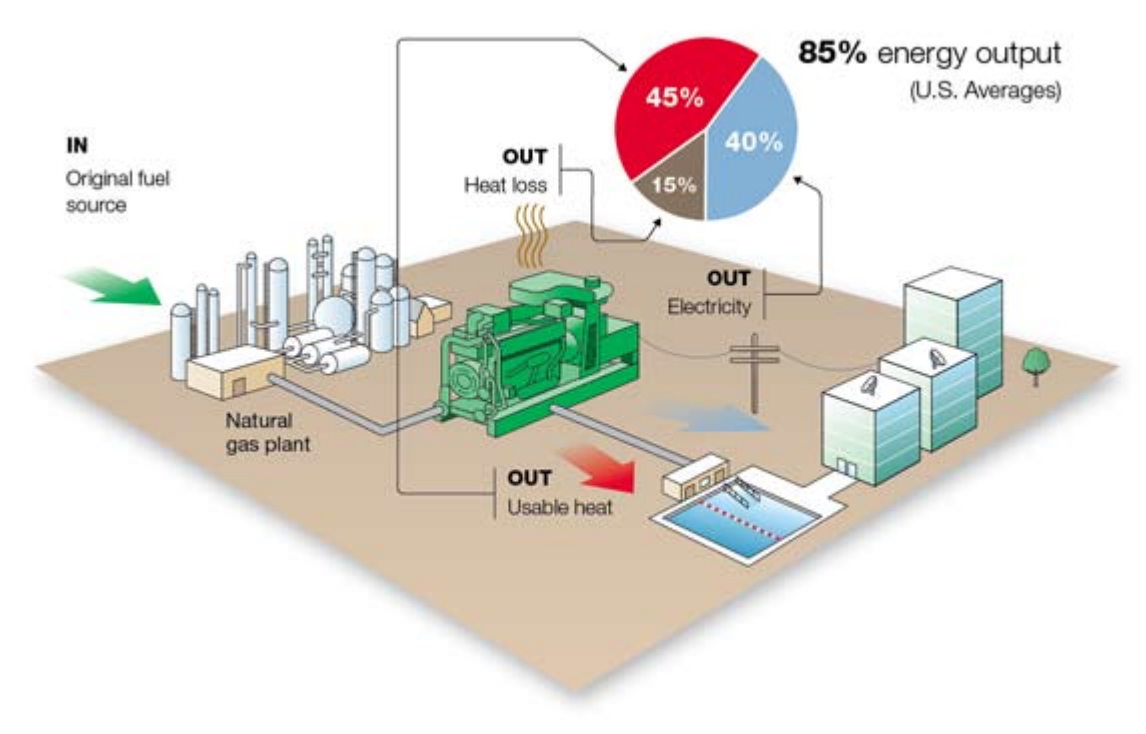
Cogeneration – Killing many birds with one stone

- Cogeneration, also known as Combined Heat and Power (CHP), is the on-site production of multiple types of energy — usually electricity, heat and/or cooling — from a single source of fuel. Cogeneration replaces the traditional methods of acquiring energy, such as:
  1. Purchasing electricity from the power grid and
  2. Separately burning natural gas or oil in a furnace to produce heat or steam.

- The traditional method of purchasing electric energy from a utility is very inefficient and wastes almost 75 percent of the energy in the original fuel due to production and transportation losses. Typically the energy balance is as under:

  1. Energy input – 100%
  2. Energy wasted in generation – 60%
  3. Energy wasted in transmission – 8 to 10%
  4. Energy delivered as electrical output – 30%

- On-site cogeneration systems convert 70 percent to 90 percent of the energy in the fuel that is burned into useful electricity or heat.



Is your facility a suitable candidate for cogeneration?

Almost any facility with a simultaneous need for both electric and thermal energy is a potential candidate for the energy-saving benefits of cogeneration—that is, on-site systems that produce both electric power and thermal energy from a single source of fuel. Ask yourself the following questions and if answers to all is “yes”, then your facility may be a good candidate for a cogeneration application.

1. Is the electrical load of your facility consistently greater than 1,000 kW?
   (a) Facilities with larger energy needs can generate larger savings and a shorter payback period.
2. Is the thermal load of your facility equal to 1 million Btu / hr or more?
   (a) This could take the form of hot water, an absorption chiller load, low-pressure steam — or a combination of all three.
   (b) Unlike excess electrical power which can be fed back into the grid, excess heat usually ends up as waste heat, lowering overall efficiency.
3. Is the duration of your simultaneous need for heating/cooling and electric power greater than 4,000 hours per year?
4. Is the cost of electricity significantly higher than cost of natural gas?
   (a) Greater the differential between the price of electricity and the price of natural gas (equivalent Btu basis), there is greater the likelihood of savings.
5. Is reliability of electric service a major economic concern?
   (a) For many commercial and industrial facilities, a power outage can be very costly. On-site cogeneration systems — when designed properly — offer significantly better reliability than local utilities. They are less vulnerable to vandalism and transformer or trans mission line failures, and, with proper maintenance, will offer decades of reliable operation.

Sources of heat:

The thermal energy contained in the exhaust gas and cooling systems generally represents 60 to 70 percent of the inlet fuel energy. Waste heat from engine is available in the following:

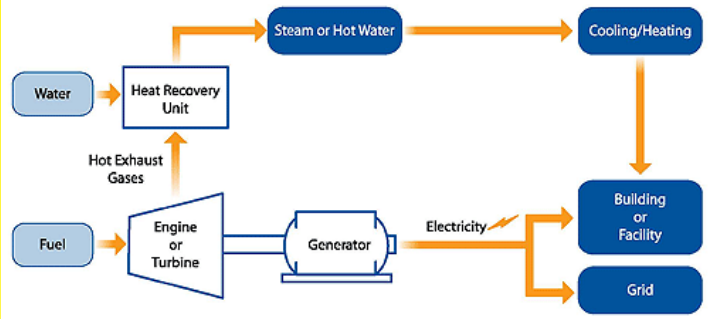
1. Engine exhaust 2. Jacket coolant, 3. Lube oil cooler and 4. Turbocharger’s intercooler and after-cooler (if so equipped).

Amount of heat recovered is in direct proportion to the:

1. Exhaust gas mass flow rate, exhaust temperatures and minimum temperature exhaust can be cooled down to.
2. Mass flow rate of cooling water in LT and HT circuits and maximum outlet temperatures achieved respectively from the both.

It is important to note that:

3. Heat in the engine jacket coolant accounts for up to 30 percent of the energy input and is capable of producing 90 to 95°C hot water.
4. Engine exhaust heat represents from 30 to 50 percent of the available waste heat. Exhaust temperatures of 450 to 650°C are usual. By recovering heat in the cooling systems and exhaust, approximately 70 to 80 percent of the fuel's energy can be effectively utilized to produce both power and useful thermal energy.



5. Exhaust heat is typically used to generate hot water to about 100°C or low-pressure steam (up to 150 psig).
6. Only a portion of the exhaust heat can be recovered since exhaust gas outlet temperatures are generally kept above a certain level (120 to 180°C) to prevent the corrosive effects of condensation in the exhaust piping.
7. Exhaust heat recovery can be independent of the engine cooling system or coupled with it. For example, hot water from the engine cooling can be used as feed water or feed water pre-heat to the exhaust recovery unit. In a typical heating system, jacket cooling, lube oil cooling, single stage after-cooling and exhaust gas heat recovery are all integrated for steam production.
8. Heat which is required to convert feed-water at 100 °F (38°C) into steam at 150 psig (15 bar) is equal to 1128 BTU
9. Quantity of 100 to 150-psig steam which is required to produce one ton of refrigeration / air-conditioning is 10 lb (4.5 kG)