VIII. Waste Heat Recovery [i]

Introduction

Waste heat is the heat generated in a process or operation due to fuel combustion or any chemical reaction, which is then wasted into the environment and is not used for any economic purposes. This waste heat if recovered and used for economic purpose prevents consumption of fossil fuel and improves production efficiency. Methods of waste heat recovery includes transfer of heat for cooling requirements, preheating purposes, transferring heat to load which is about to enter furnace, generating mechanical or electrical power and using heat pump for heating or cooling purpose.

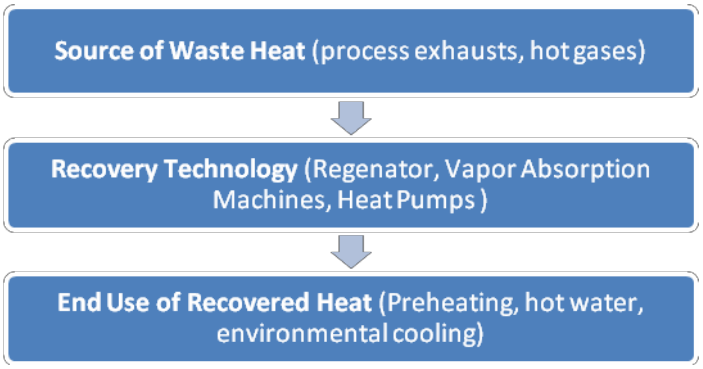

Figure 9: Key components of WHR

Technology characteristics

Various equipment such as Heat Exchangers, Vapour Absorption Machines (VAM), Recuperators, Regenerators, Waste Heat Boilers and Heat Pumps are utilized for purpose of WHR. For implementation of WHR projects in industries three components are studied essentially which include i) source of waste heat ii) feasible technology for recovery iii) use for recovered energy[23].

In Bhutan, the waste heat source is primarily available with Iron & Steel and Ferro Alloy industries. Since the size of industries is quite small, the temperatures of heat sources in the industries are comparatively low. According to the Bhutan Industry Association, the temperature of waste heat (in form of steam) in Ferro Alloy industry is nearly 300 degree Celsius. For this temperature range, the recovered heat may not be used for power generation and other conventional applications as compared to waste heat recovered from large iron and steel industries where temperature of heat sources is as high as 1000 degree centigrade.

However, through use of Vapour Absorption Machines (VAM) using waste steam at 300 degree Celsius environmental cooling and chilled water production is feasible. VAM could be used with steam pressure as low as 0.5 KG/cm^2. In addition, heat pump can also be used to extract heat from cooling water (used in chillers) and reduce energy consumption required for water heating in industries. Absorption Heat Pump generates the hot water based on 75% heat from heat source (e.g. diesel, steam, gas). Hence 25% heat from existing sources (diesel, gas, steam) can be saved. The concept is shown in the below figure 5.

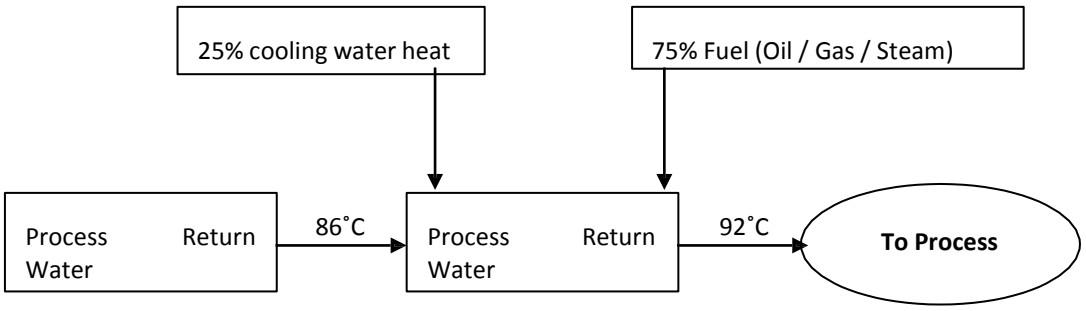

Figure 10: Illustration of energy efficiency through use of Heat Pump

Therefore, the recovered waste heat in Bhutan's industries can be best utilized for water heating, room heating/cooling and other process heat requirements. In addition, since the industries in Bhutan are located in close vicinity, waste heat recovery can be done in cluster basis and the heat utilized from one industry can be used in other industry as process input.

[23] Waste Heat Recovery: Technology and Opportunity in US Industry, US Department of Energy, https://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf page 10

Country specific applicability and potential

All the technologies discussed above can be used in Bhutan as discussed above. For more details refer to Technology Action Plan Report for Waste Heat Recovery technology.

Benefits to economic / social and environmental development

Enhanced energy savings and resource efficiency thereby increasing production efficiency

Reduced Volatile Organic Carbons (VOCs) such as NO_X, SO_X, particulate matter.

Health benefits to the employees of the plants due to reduced pollution inside the plant[24].

Climate change mitigation benefits

Waste Heat Recovery technologies can reduce GHG emissions by reducing consumption of grid electricity, coal and other fossil fuel such as diesel in industries.

Financial Requirements and Costs

The cost of Waste Heat Recovery depends on the choice of the technology and application of waste heat in the industry. A case study shows that replacing split AC units with waste heat driven absorption chillers will cost around $50,510[25]. Based on estimates taken from few technology suppliers, systems which can tap heat upto 300 degree Celsius for various purposes may cost in the range of $50,000 to $100,000 excluding transportation cost which could be significant in case of Bhutan.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment and Technology Action Plans For Climate Change Mitigation– Bhutan. You can access the complete report from the TNA project website http://tech-action.org/**