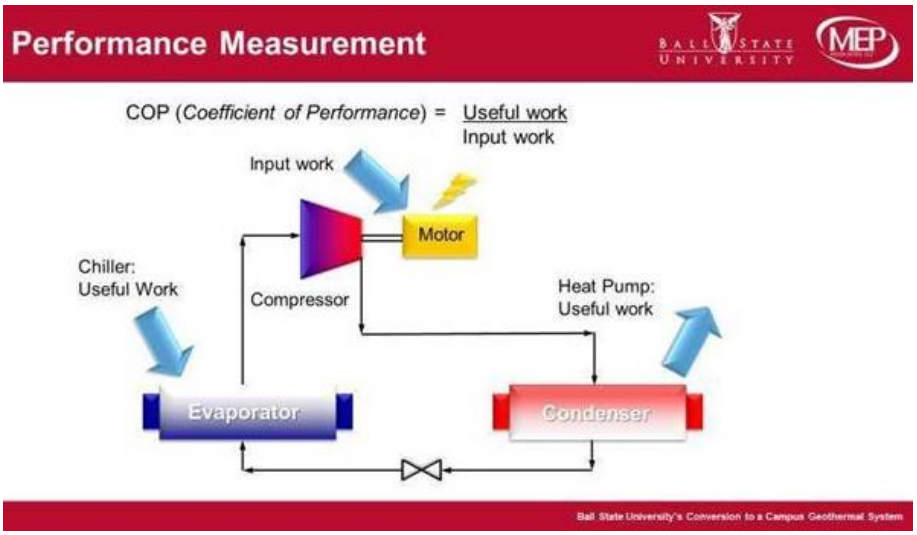
The Leveraged Coefficient of Performance
of the
Ball State University District-Scale Heat-Pump-Chiller System

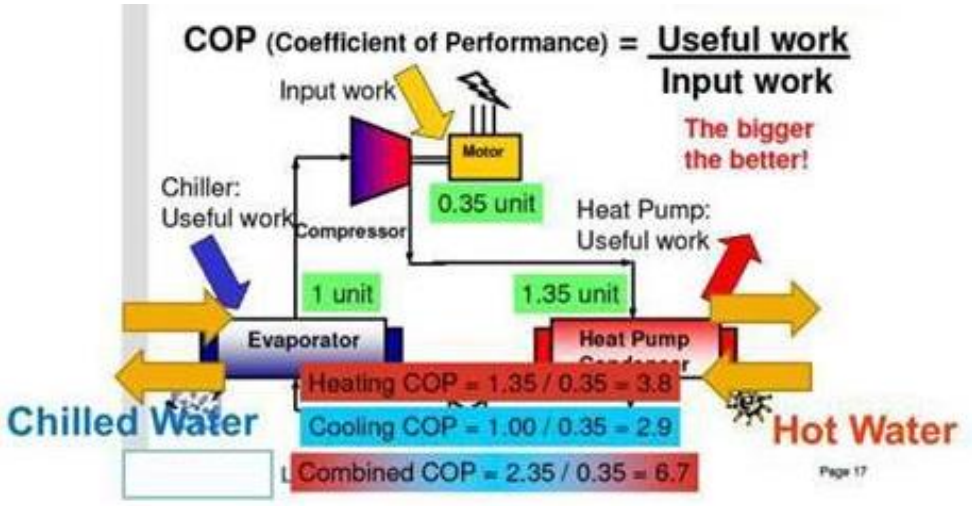
The anticipated 7.77 Coefficient of Performance (COP) listed in the BSU Geothermal White Paper combines the COP ratings of the three parallel functions of the heat pump chiller operation.

Specifically, the ratio of useful work resulting from the input of work for those functions.

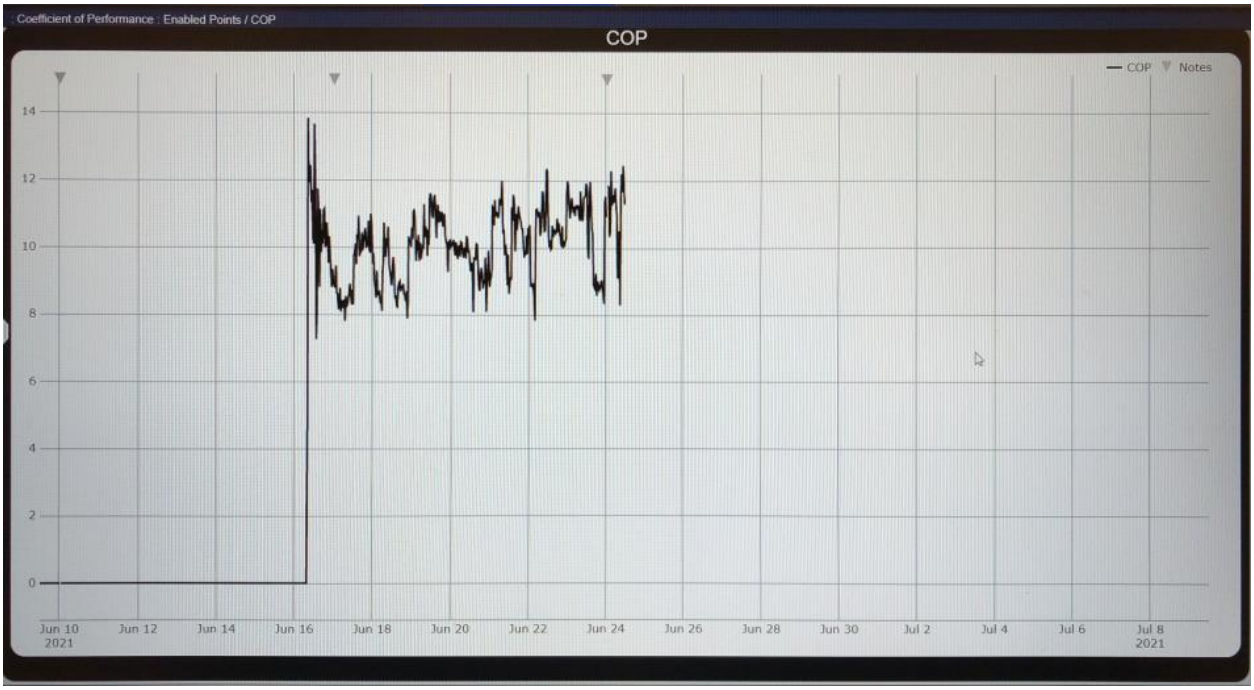
The electrical power consumed by the system drives an evaporator and a condenser producing chilled water and hot water, respectively. In addition, as the district scale system simultaneously circulates these chilled water and hot water loops around the campus enables the 'trading' of energy from one building to another. This amplification of system performance is a by-product of the electrical power consumption of the primary pumping motors. Thus the COP of the system is a combination of all three functions of the District-scale system.



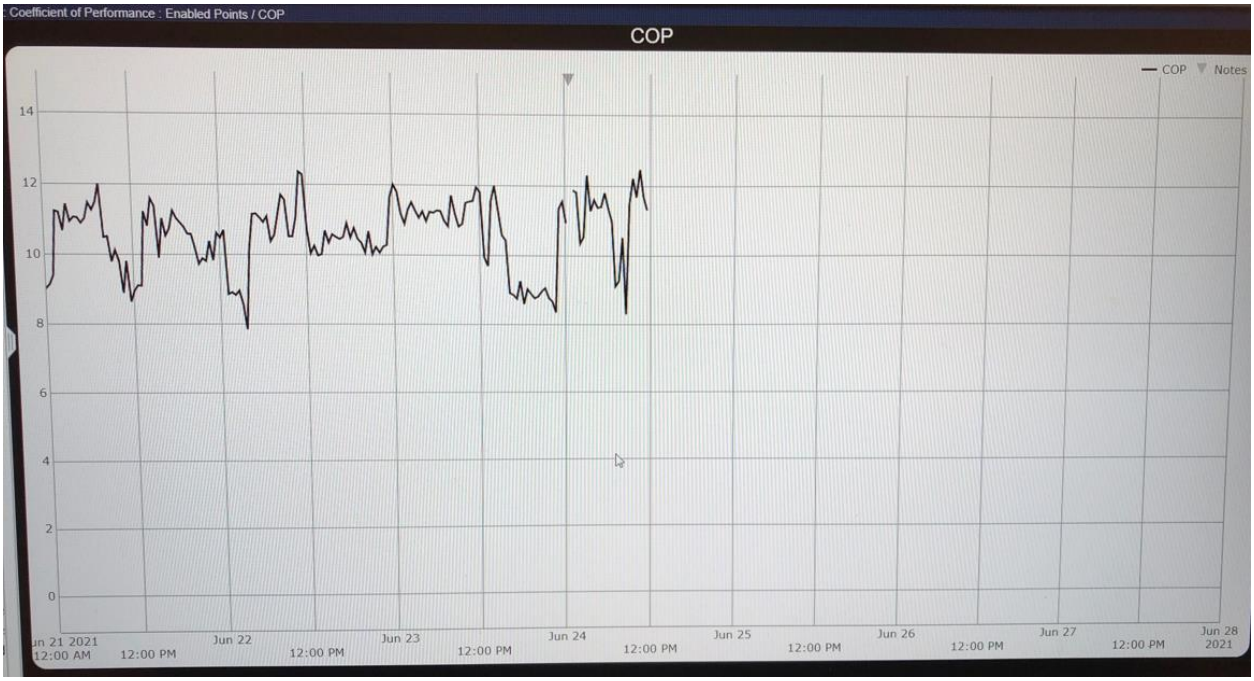
The early analysis of the project design, showed the system COP to be a combination of a cooling COP of 2.9 and a heating COP of 3.8 with the additional COP for the cycling of 1000 tons of thermal energy throughout the year of 1.07. These together yielded an estimated COP of 7.77



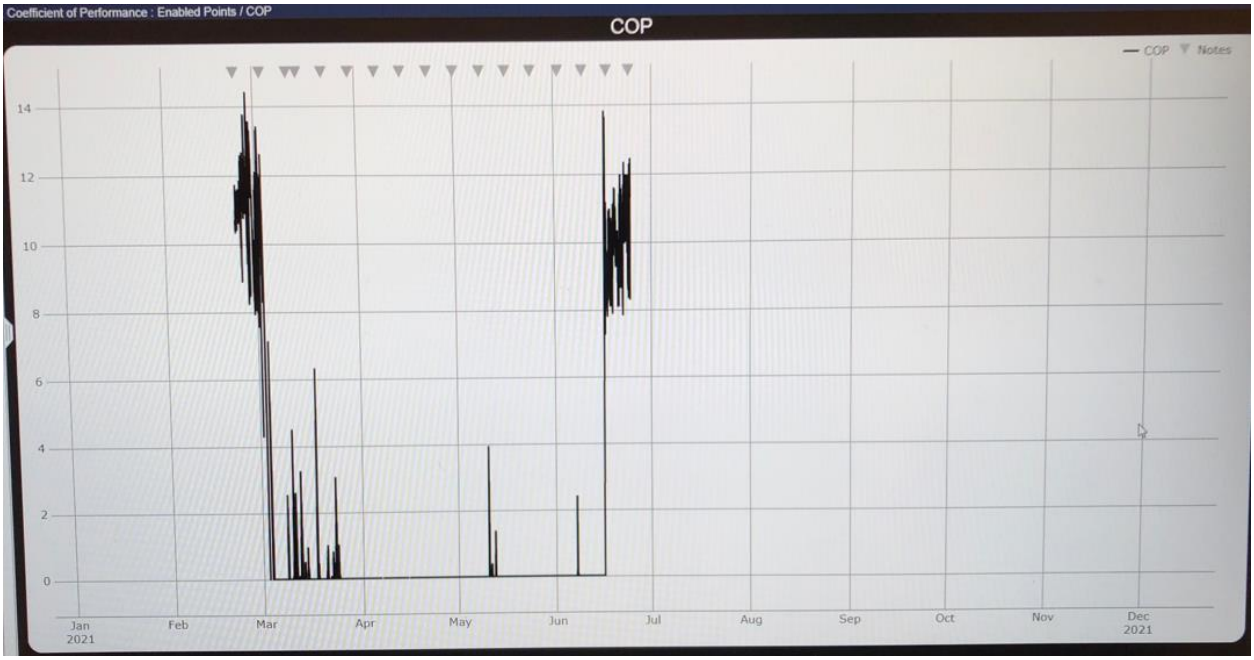
In point of fact the dashboard monitoring of the system operation has shown a system performance consistently exceeding that number. As illustrated in the following three graphs, the heat pump chiller performance as monitored in a single energy station and campus loop is operating at a COP between 8 and 10; occasionally reaching 12. This remarkable efficiency is a function of the scale of the system.



District Energy Station North (DESN) __A few days



District Energy Station North (DESN)__One week



District Energy Station North (DESN)__One year

NOTE:

The flat lines on the graphs reflect the fact that the District Energy Station South (DESS) has been tasked during that time to ‘feed’ the campus loops.