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Sustainability: Reusing Data Center Waste Heat

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Anthem is one of the largest health benefits companies in the United States. It serves around 71 million people. The building in Richmond Virginia is the most energy and water intensive location. The building is 544,408 ft² with a data center of 50,000 ft² in the middle of it. The data center consists of over 1000 racks that include the servers in them. And as shown in the picture, the data center is designed as the hot aisle/cold aisle concept, it helps to separate the cold air and hot air from mixing. And that takes us to the CRAH unit which is a device used to deal with heat produced by the servers. As the cold air enters the data server room from underneath the floor to the servers and gets contained in the cold aisle, it allows the hot air to be expelled into the contained hot aisle. Then the hot air rises up to the ceiling and gets drawn through the CRAH unit and then returned back to the system as cold air. The heat in the CRAH unit is exchanged into water. The hot water is pumped up to the water tower and the cold water leaving the chiller returns to the CRAH unit, and the cycle begins again. By using this current heat recovery system, the data center rejects 2,000 tons of waste heat into the atmosphere which is twice the amount of heat needed again. By using this current heat recovery system, the data center rejects 2,000 tons of waste heat into the atmosphere which is twice the amount of heat needed. By using this current heat recovery system, the data center rejects 2,000 tons of waste heat into the atmosphere which is twice the amount of heat needed. By using this current heat recovery system, the data center rejects 2,000 tons of waste heat into the atmosphere which is twice the amount of heat needed.

By adding an additional condenser bundle to an existing centrifugal chiller, an additional loop of higher temperature water can be used to preheat the make up air. The chiller would still be able to run at normal efficiencies when the extra heat recovery is not necessary. By using a 4 inch pipes, the 120° F water would be piped through an existing chilled water coil, located within the two make-up air handlers located in the penthouse. This would reduce the amount of natural gas used to pre-heat the air entering the building. This hot water loop could also be used to supplement the boiler used for domestic hot water. This results in a GPM of 206 for the coil. Therefore, each make up air handler will be produced: 

$$Q = m \times c_p \times \Delta T$$

For the air side, the Q value was determined to be $Q = 36,000 \text{ CFM} \times 1.045 \times 55° \text{ F}$. This Q value was then compared to the coil to determine the necessary GPM or volumetric flow rate for the coil. 

$$\text{GPM} = \frac{Q}{(c_p \times \Delta T)}$$

This results in a GPM of 206 for the coil. Therefore, each make-up air handler would be equipped with a coil.

Cost Analysis:

Currently, Anthem spends $100,000 annually on natural gas with a heating load of 12 million Btu/h during the winter. With the combined heat transferred through both make-up air handlers, the total reduction will be 4.14 million Btu/h. This leads to a reduction coefficient of 0.345. Applying this to the natural gas annual cost, it equates to a savings of $34,500 each year, including the insulation cost of $150,000. The payback period would be 4.34 years.