**EXECUTIVE SUMMARY**

River Vue Apartments is a renovation project to turn the Old State Office Building located downtown Pittsburgh, Pennsylvania into a high rise multifamily apartment complex. The site is tightly constrained by neighboring buildings and historic sites and most of the existing structure will remain with the exception of fenestration which will be replaced to lighten the solar gains.

Preliminary research of the existing mechanical system indicated that ventilation is provided by the single make up air handling unit whereas heating and cooling is supplied by heat pumps located in each apartment unit. Ventilation does not meet current minimum values recommended by ASHRAE Standard 62.1. Loop water serves the heat pumps and a chilled water loop provides water for domestic use and minimal floor space is lost on each floor due to mechanical equipment and shafts.

A formal research project was conducted to understand design alternatives to the mechanical system that may improve occupant comfort or energy savings. It was found that in order to improve ventilation to meet current ASHRAE Standard 62.1 minimums, a larger air system would consume more annual electricity and create more emissions. However, energy savings can be found through the use of demand control ventilation coupled with carbon dioxide sensors to monitor building occupancy. Further energy savings was achieved through the addition of an economizer rather than other energy recovery techniques discussed. The capital cost is greatly reduced when implementing this design because of the removal of hydronic piping, heat pumps and fittings which are expensive and labor intensive.

An electrical study was conducted to analyze if use of a photovoltaic array could be used to either supplement the annual electric requirement of the building or power internal shading devices that could lower the solar sensible heat gains to the spaces. Research proved that the available space for an array would not provide enough electricity to power the desired shades and the electricity harvested off of the array would only offset the building’s energy use by three percent, making the proposed design invaluable for its high capital cost. Payback would not occur in the expected life cycle of the building’s operation. An array of 100 times the size of the available space is required to make a significant impact on annual electric use.

Schedule changes would be significant if the proposed mechanical system replaced the existing one because the labor required for duct installation is much less. 27% of the original time dedicated to rough-in can be decreased to 340 days of working time and MEP finishing can be reduced by 24% with the elimination of heat pumps. Punch list and inspection time was almost fully maintained from the original schedule because of the new air system’s testing and balancing requirements during start up procedures.

The reduction in water usage, improvement of indoor air quality and other attributes of the proposed mechanical design assist the improvement of the LEED score to nearly 40 points, making LEED Silver certification a possibility for River Vue Apartments, an improvement over the original desire for LEED Certified.