PENNSTATE **Borland Laboratory Renovation**

Final Proposal

For Spring Thesis Project

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Construction Management Option

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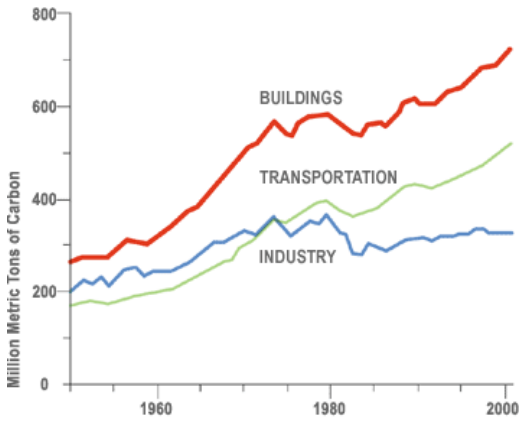
Analysis 1:

AIA 2030 Challenge on Building Renovations

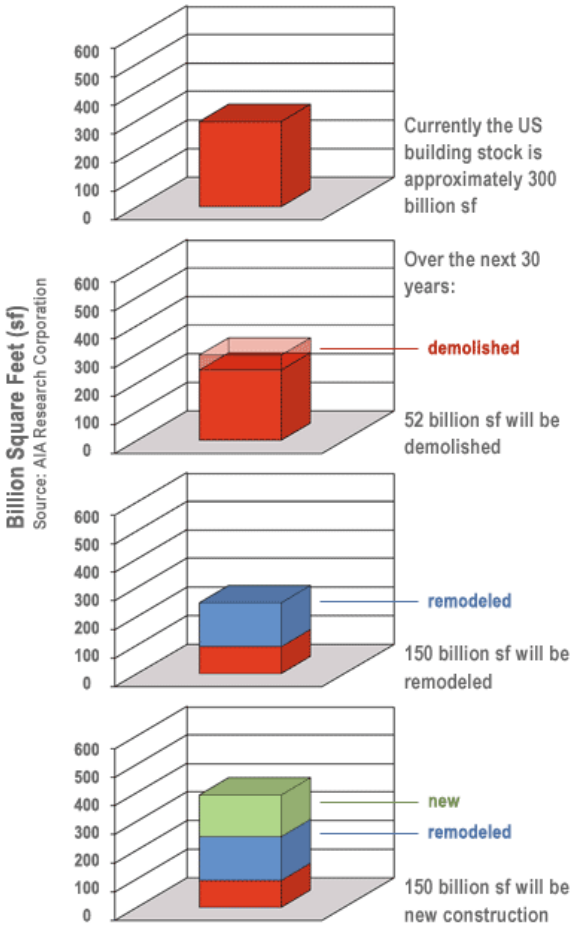
Unknown for many years, the construction industry has posed a huge effect on the greenhouse gases that pollute this world. Bellow is a graph comparing the major carbon creating industries showing that the building industry is the highest.



Source: U.S. Energy Information Administration statistics

The American Institute of Architects (AIA) has proposed a plan called The 2030 Challenge to fix this problem. An investigation done by the AIA Research Corporation has determined that by the year 2030, 150 billion square feet of building renovations will be completed. Also 150 billion square feet of new construction will be done.

Since the Borland Laboratory Renovation is a remodeling project this proposal will look at how the construction industry can become greener with renovation projects. The goal is to reduce the use of fossil fuels to construct and operate all buildings by the year 2030, making them carbon-neutral. This must be completed by designing high-performance, carbon-neutral buildings as well as renovations. As seen bellow in a diagram done by the AIA research Corporation, the remodeling industry is a great part of the total construction done in the country.



There are many solutions to this ever increasing problem. As any solution goes, it must start at the beginning of the problem. This is the education of new architects and construction industry members. There should be a mandatory class taken discussing how building can be built and designed in a more efficient manner. In concurrence with this, the manufacturers of building materials must become more carbon-neutral. This can be done by, making high-performance glazing for glass materials, better insulations, and more efficient mechanical systems along with many others. Another helpful step in this project is to manufacture these materials using green energy. Green energy can be found in many places such as photovoltaics, solar hot water, fuel cells, micro-hydro, wind, geo-exchange, etc.

Possibly the biggest challenge for this project will be to convince the owners, and future builders to make there properties more carbon-neutral. In accordance with this, a resolution has been proposed to adopt the 2030 challenge in city buildings. Saying; The U.S. Conference of Mayors will encourage its members to adopt the following "2030 Challenge" for building performance targets. New construction, renovation projects, repairs and replacements of city buildings shall be designed to achieve a minimum delivered fossil-fuel energy consumption performance standard of one half the U.S. average for that building type as defined by the U.S. Department of Energy. Also to follow green building practices to the maximum extent possible. (*Resolution No. 50* - ***http://www.mayors.org/74thannualmeeting/resolutions/proposedresolutions_energy.pdf***)

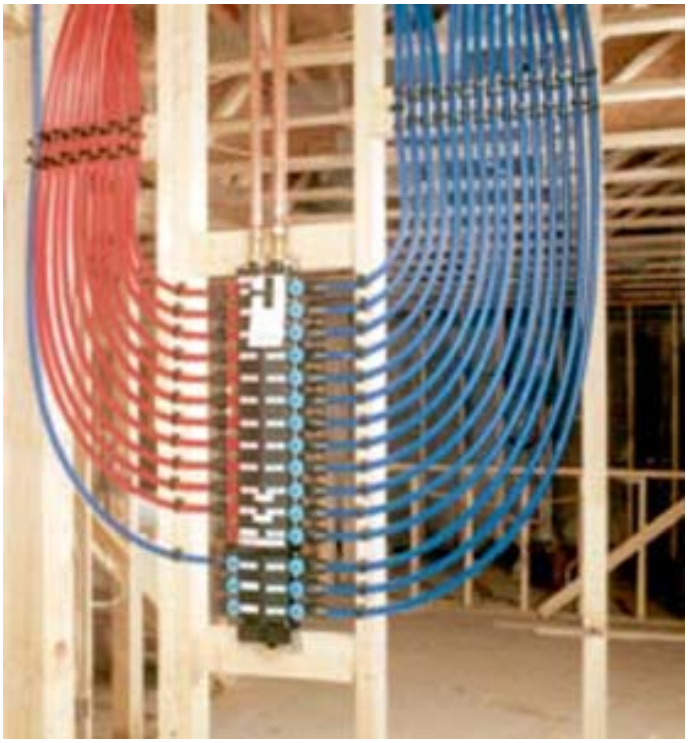
Analysis #2 (Breadth)

A Redesigned Domestic Water Piping System

In concurrence with the 2030 challenge, this analysis will discuss redesigning the domestic water piping system to a more green material. The current piping system consists mostly of steel and copper tubing. A new system will be designed using a cross-linked polyethylene tubing. Contrary to popular belief, this product also known as PEX is a green material. It is often confused with a normal polyethylene tubing called PE which causes many toxins when manufactured. Also PE tubing was unable to be ground up and recycled for new tubing. New developments allow the PEX tubing to be recycled and also give it a much longer life span. PEX tubing is manufactured cleanly and consumes far less energy than the manufacturing of metallic piping.

Helping the environment isn't the only benefit to using this product. The Borland Laboratory Renovation is a perfect place for PEX tubing to be used. Since this is a plastic like material, it allows the tubing to be bent around corners and odd shapes without the use of extra fittings. This project is an existing building which would make it difficult to run ridged copper tubing around the many obstacles that exist in the floor and ceiling plenums.

The redesigned system will include the use of a manifold or home run system for hot and cold water. Each floor will be split up into two zones, each of these zones will have a dedicated manifold for hot and cold water. Hot and Cold water is piped into the manifold in each zone from the basement, and then distributed to all of the fixtures located in its zone from this central location. This allows for faster hot water delivery, which in turn causes less wasted water. Also a manifold system allows for excellent pressure balancing between all of the fixtures. A major advantage to this system is the ability to isolate an individual fixture when maintenance is required instead of shutting off an entire zone. An example of a manifold system can be seen bellow.



The use of a PEX system is a very effective way to gain a budget and schedule reduction. PEX tubing itself is much cheaper to purchase than copper tubing however when using a manifold and home run system, this requires more piping, which eliminates these savings. The budget reduction comes from the labor of installation. Since PEX tubing is very bendable, it doesn't require as many joints to be installed compared to copper tubing. This not only allows for a schedule and budget reduction, but also causes less maintenance due to leaks. The biggest reductions for this project will be in the booster pump. Since the PEX tubing system will be using a manifold system, this will either eliminate the need for a domestic water boosting pump, or allow for a smaller pump to be used. The picture bellow shows how effectively this tubing can be bent with out the need of fittings.

Analysis #3

Crane Placement

The Current Location for the crane on the Borland Laboratory Renovation is on the north side of the building. This location could cause problems of interfering with the Agriculture building which is located approximately 50 feet away from the designed crane locations. This building has a very high flow of student activity, as well as an active work shop located with-in the swing distance of the crane. Along with these potential problems, there are two very large trees that are protected under Penn State's Heritage Tree Act.

In order to eliminate these problems, it has been proposed to locate the crane in the area of the ice cream sales room, on the south side of the building, after it has been demolished. This will cause only positive effects on the budget and schedule of work; also it will better protect the student population.

Another benefit by moving the crane to this location will be a smoother flow for delivery truck traffic through the site. The Borland Laboratory Renovation site is very congested and doesn't allow any room for a staging area for the steel erection. Therefore, the steel will be picked right off of the truck and put into place.

The new location for the mobile crane will allow all steel delivery trucks to enter the site from the gate on Shortlidge Rd. and drive along the east side of the building, where the crane can then pick from the truck. The trucks can then exit directly onto Curtain Ave.

A slight problem exists with this plan however. With the crane located on the south side of the building, the reach will extend over the sidewalk along Curtain Ave. This will be easily solved by adding in a sidewalk cover. Further research will be completed to find the rental price of such equipment. This will in turn then be compared to the possible budget and schedule savings by moving the crane. Following are two diagrams showing the original and revised locations for the crane. The delivery truck path has been added to show the flow of trucks through the site.

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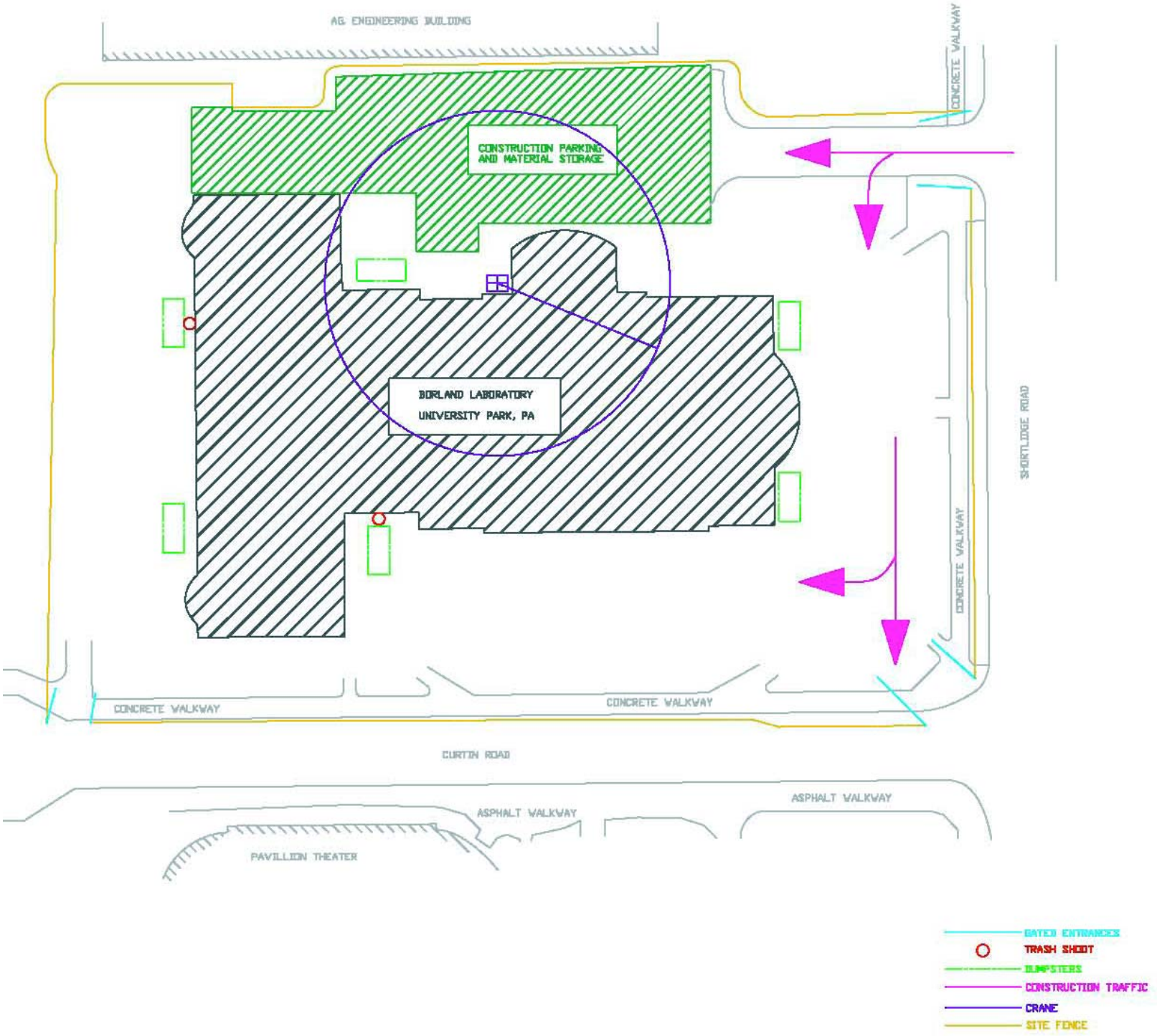
Original Crane Location:



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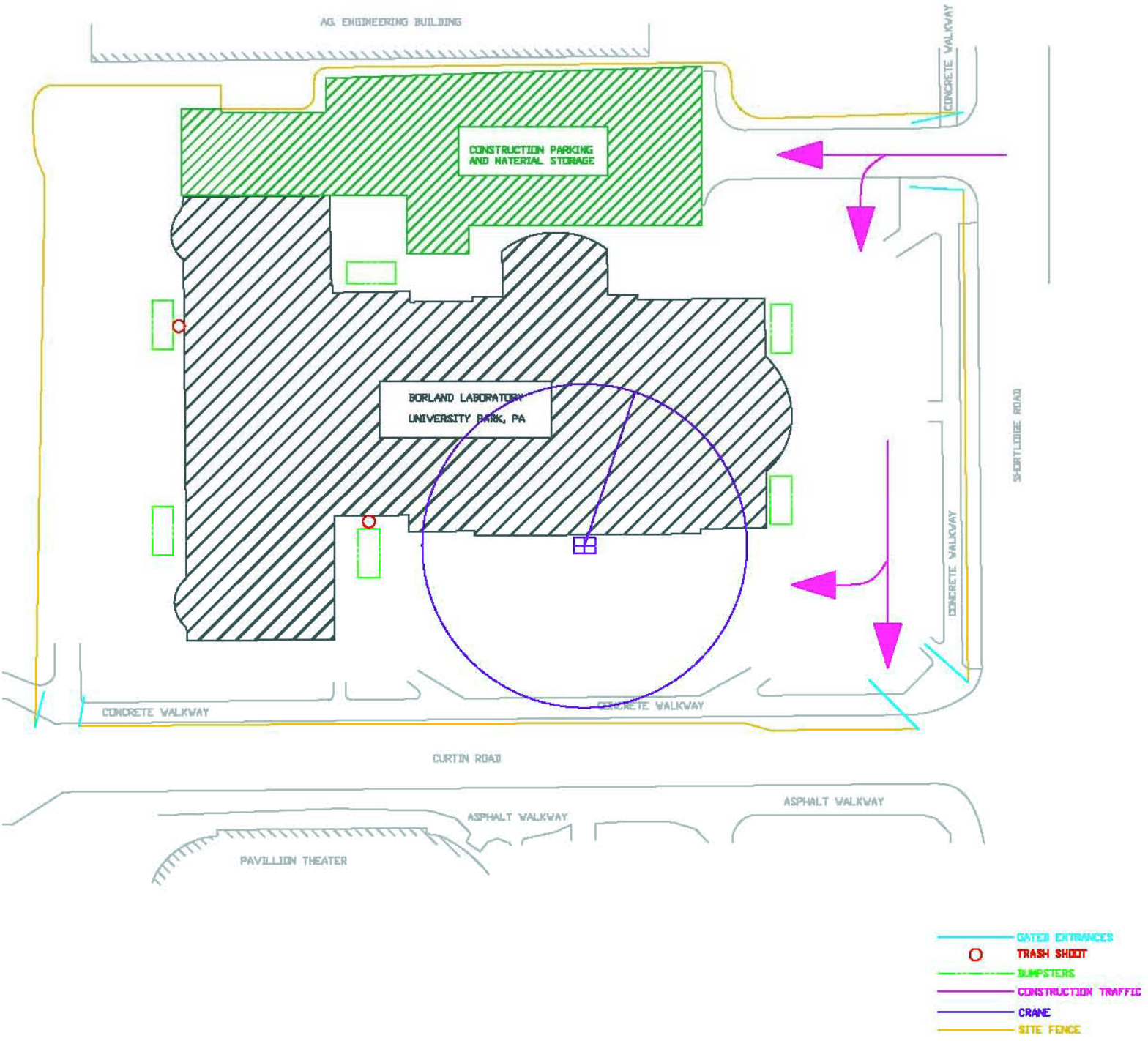
New Proposed Crane Location:



Analysis #4 (Breadth)

Redesigned Green Mechanical System

Following with the AIA 2030 Challenge, Penn State is trying to due its part. The Borland Laboratory Renovation will be the first renovated building on a Penn State Campus to be LEED Certified. The amount of points specified for this building is very close to obtaining a Silver LEED Rating. This could easily be accomplished by changing a few small things in the demolition phases of the project. However, a great way to work toward the 2030 challenge is to use a green mechanical system on this project.

The mechanical system will be redesigned to make it more carbon-neutral. In a typical HVAC system, some of the major energy consumers are for fans and outside air. While redesigning, the system for this project, the following will be considered:

- The use of variable speed motors to minimize energy usage when the system is not running at full capacity.
- A heat recovery system will be used to pre-treat the ventilation air.
- Optimize lighting and designed wattages to minimize the impact of extra heat sources

- Optimize insulation and window glazing designs to minimize the solar load on the system.
- Properly size ductwork and air handling units (AHUs) to minimize fan horsepower.
- Regulate outside air according to occupancy, activities, and operations.
- Zone the building using VAV distribution systems.
- Finally, commission the system to ensure proper balancing and operation.