SESSION E5 CAMPUS CASE STUDIES

SUSTAINABLE STRATEGIES FOR EXPANDING A LARGE R&D CAMPUS

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WSP BUILDING SYSTEMS
LEARNING OBJECTIVES

CONSIDERATIONS WHEN DECIDING TO RENOVATE AN EXISTING BUILDING OR BUILD NEW

CONSIDERATIONS FOR USING CENTRAL CAMPUS UTILITIES VS. STAND ALONE BUILDING SYSTEMS

HOW TO PHASE ENERGY EFFICIENT UPGRADES INTO EXISTING FACILITIES

HOW TO OPTIMIZE EFFICIENCY THROUGH TECHNOLOGY

SUSTAINABLE STRATEGIES FOR EXPANDING A LARGE R&D CAMPUS
150 ACRE – 1.5 MILLION LAB/OFFICE SQUARE FEET – 10 BUILDING SITE – TARRYTOWN, NY

Timeline

1969 – Union Carbide Construction (5 Buildings)
1989 - Regeneron leases 12,000 square feet
1999 – Campus purchased by LCOR
2007 – Campus purchased by BioMed Realty
2010 – BioMed Constructs three (3) new Buildings 365,000 square feet for Regeneron
2015 – BioMed Constructs two (2) new Buildings 300,000 square feet for Regeneron
2016 – Regeneron purchases campus from BioMed
RENOVATE EXISTING OR BUILDING NEW

Renovation Space

New Space
New Building

*Shafts/Penetrations:*
- New and Placed Where Required

*Mechanical Space:*
- Large Open Penthouse – Blank Canvas

*Energy Efficient Equipment:*
- Condensing Boilers, Enthalpy wheels, VAV systems, Advanced lighting controls.

*Emergency Power:*
- New Generator and Support Infrastructure properly sized.

*Pre-purchase Equipment:*
- AHU, Generator, Lab Exhaust, Boilers

*Impact to MEP design from other tenants:*
- No Impact – Single tenant building

Renovated Space

*Shafts/Penetrations:*
- Existing Shafts did not work with new program.
- Impacted tenant below, required careful coordination.

*Mechanical Space:*
- Very crowded and resulting in compromised solutions

*Energy Efficient Equipment:*
- More difficult to incorporate.

*Emergency Power:*
- Costly and difficult to accommodate

*Pre-purchase Equipment:*
- Pre-fabricated mechanical plant, Generator, Lab Exhaust

*Impact to MEP design from other tenants:*
- Large impact resulting in design comprises.
RENOVATE EXISTING OR BUILDING NEW

**New Building**

*HVAC*
- Lab AHUs – N+1
- Fume Hood Exhaust N+1
- Boilers: N+1
- Chillers: N+1

*Power*
- Back-Up Generator for all Critical Loads and HVAC systems

**Renovated Space**

*HVAC*
- Lab AHUS – No Redundancy
  Limited by Space
- Fume Hood Exhaust N+1
- Chillers: Redundancy via multiple compressors in each chiller. Limited by Space and electrical capacity for full N+1

*Power*
- Back-Up Generator for all Critical Loads and Freezer Farm HVAC only. Limited by Space.
# RENOVATE EXISTING OR BUILDING NEW

## Pros and Cons of Energy Recovery Options

### Energy Recovery Wheel
- **Pros**: High transfer effectiveness; Latent + Sensible; Low pressure drop; Little maintenance
- **Cons**: Increased service in cold climates; Cross-air contamination possible; Air streams need to be adjacent to each other
- **Required Maintenance**: Clean medium of dust; Maintain drive motor and train; Inspect wheel for proper belt and chain tension

### Runaround Coils
- **Pros**: Exhaust airstream can be separated from supply air; Fan location not critical; Flexible; Little maintenance; No cross-air contamination
- **Cons**: Only transfers sensible heat energy; Freeze protection needed (glycol)
- **Required Maintenance**: Clean coil surface; Maintain pump and valve; Refill or replace transfer fluid

### Air to Air Heat Exchanger
- **Pros**: High transfer effectiveness; No moving parts; Low pressure drop; Easily cleaned
- **Cons**: Total heat recovery only available in certain units; Effectiveness of permeable membrane for latent heat transfer is not widely accepted
- **Required Maintenance**: Clean or change filters; Inspect and clean condensation pan and drain tubing; Clean heat exchanger core; Clean fan blades; Maintain fan motor
## Summary of Cost Savings – All Options

<table>
<thead>
<tr>
<th>Designation</th>
<th>Option #1: Air-To-Air Heat Exchanger</th>
<th>Option #2: Run Around Coil</th>
<th>Option #3: Enthalpy Wheel</th>
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<tbody>
<tr>
<td>AHU-1-2</td>
<td>17,339.01</td>
<td>23,805.91</td>
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<td>Totals</td>
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<td>$143,593.68</td>
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**Air to Air Heat Exchanger**
- 55% Sensible Only Energy Recovery

**Runaround Coils**
- 55% Sensible Only Energy Recovery

**Energy Recovery Wheel**
- 85% Total Energy Recovery
RENOVATE EXISTING OR BUILDING NEW

**Energy Recovery Wheel**
85% Total Energy Recovery
*Used in New Building*

- Reasons For Decision
  - Most Energy Efficient
  - Large Penthouse was Easy to Accommodate Space
  - Close Adjacency of Outdoor and Exhaust Air Streams

**Runaround Coils**
55% Sensible Only Energy Recovery
*Used in Renovation*

- Reasons For Decision
  - Option that could be easily phased and integrated into existing space.
  - Reduced Large footprints.
  - Lower First Cost
Approximately 30% More Efficient After Renovation.

- New Energy Recovery
- Enhanced Lighting Controls
- Air Flow Setback
2016 - Regeneron Purchases Campus
Central Utility Services and Centralized Redundancy becomes an Option.

<table>
<thead>
<tr>
<th>Building</th>
<th>Area (sq. ft.)</th>
<th>Site Chilled Water</th>
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<tbody>
<tr>
<td>5</td>
<td>125,000</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>115,000</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>125,000</td>
<td>No</td>
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<tr>
<td>4</td>
<td>175,000</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>78,000</td>
<td>Yes</td>
</tr>
<tr>
<td>769</td>
<td>88,000</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>61,000</td>
<td>Yes</td>
</tr>
<tr>
<td>1 &amp; 3</td>
<td>320,000</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>100,000</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>200,000</td>
<td>Yes</td>
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</table>
• Original chilled water system has *no redundancy* in pumps and cooling towers during periods of high loads.

• **Old Electrical Equipment is past useful life** - original to the site (+40 years old)

• Local power generators do not have capacity for expansion projects in 777 and 765.

• Underground chilled water piping condition is *unknown* and 50 years old.
RISK MITIGATION

• Original chilled water system has **no redundancy** in pumps and cooling towers during periods of high loads.

• Reconfigure piping and pumping in chiller plant to allow for redundancy and replace cooling tower fill to restore original performance.

• Keep backup chillers to support critical research local to buildings as we added new spaces.

• **Old Electrical Equipment is past useful life** - original to the site (+40 years old)
  • Upgrade existing switchgear as new projects come online.

• Local power generators **do not have capacity** for expansion projects in 777 and 765.
  • Added local generators to buildings as we added new spaces with emission controls and high end filtration.

• Underground chilled water piping condition is **unknown** and 50 years old.
  • Keep chilled water piping until next major renovation.
Reasons for Implementation

- Opportunity during planned construction projects.
- Utility Incentives to help offset cost.
- Part of planned energy reduction campus strategy to meet corporate goals.
- Short term ROI.
Upgrades to date

- 2010 - Lutron Quantum – Lighting controls.
- 2013 - Metering – Installed meters for all energy points to monitor energy reductions.
- 2014 - Low E Window Film – Reduces solar heat gain.
HOW TO OPTIMIZE ENERGY EFFICIENCY THROUGH TECHNOLOGY

Smart Buildings
• Use less energy
• Enhances safety
• Increases comfort

Grid Modernization
• Allows buildings to provide energy
• Increases resiliently
• Enhances reliability

Smart Buildings that are integrated with Grid Modernization ENABLE:

SCIENCE TO MEDICINE®
QUICK FACTS:

- **1729 (315W) SOLAR PANELS**
- **16 AC/DC INVERTERS**
- PROVIDES GRID PARALLEL POWER TO CAMPUS MEDIUM VOLTAGE LOOP
- PEAK POWER: **464KW** ON JUN 14 2018, 12:30PM (equivalent to 4,640 100 Watt Light Bulbs)
QUICK FACTS:

- **12.5MW TIER 4 BACK-UP POWER**
  - REDUCE NOx AND PM
- PROVIDES 480V POWER TO BUILDINGS
- PEAK DEMAND RESPONSE POWER: ~**6.0MW**
  - **SUMMER 2015**
- CON-ED PROGRAMS: CSRP, DLRP
QUICK FACTS:
• 6 – 262.5 KW ENERGY SERVER
• PROVIDES GRID-PARALLEL POWER TO CAMPUS MEDIUM VOLTAGE LOOP AND UPS POWER TO ADJACENT BUILDING.

<table>
<thead>
<tr>
<th>Year</th>
<th>Grid (%)</th>
<th>Solar (%)</th>
<th>Fuel Cell (%)</th>
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<tbody>
<tr>
<td>Jul 2018</td>
<td>87%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Jul 2019</td>
<td>87%</td>
<td>0%</td>
<td>0%</td>
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QUESTIONS?

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