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**VIA EMAIL: lindsey.june@nyserda.ny.gov**

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Ms. Lindsey June
NYSERDA
Senior Project Manager
17 Columbia Circle
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RE: Energy Efficient Indoor Air Quality (IAQ) Analysis
Preliminary Findings Report – September Update

Dear Lindsey:

Per our contract with NYSERDA, Goldman Copeland has partnered with three real estate trusts within the New York City Class A commercial office building market to review solutions to effectively improve indoor air quality while minimizing the impact on energy consumption within the building. During the initial stage of this project, Goldman Copeland has reviewed project scope with clients, conducted initial site visits, gathered utility data, continued ongoing research, and begun preparation of a standardized draft report for the buildings. Specific progress updates for the individual buildings are delineated below.

**Changes to the document from the previous month's updates are highlighted in bold to better identify developments.**

Large Midtown Manhattan Commercial Office Building #1

Large Midtown Manhattan Commercial Office Building #1 was constructed in 1987. The building is typically fully occupied. The building has approximately 1,500 occupants during normal business hours of 8am to 6pm Monday through Friday. However, during the Covid-19 pandemic the building saw a reduced occupancy of about 5% (the building never closed). The current occupancy remains at about 5%. Each floor has one air handling unit that supplies ventilation to the space.

The building is unique amongst those included in this project as outdoor air distribution to the tenant spaces is deeply limited by the existing dedicated outdoor air system (DOAS). **The ventilation system for this building is designed such that 2 outdoor air fans supply air to a dedicated riser. Mechanical balancing dampers are installed on every floor at the riser junction and are interlocked with the floor's AHUs to reduce conditioning requirement. However, this HVAC design requires this building's measures are considered separately from the other two, and is likely detrimental to the overall energy footprint of the building. As such, a number of building specific measures are in development to control and monitor outdoor air flow.** Implementation of these measures should benefit the building beyond just providing solutions for the current Covid pandemic. **A brief description of the base building HVAC system is as follows:**

- **Heating**
  - **District steam supplied to generate HHW**
  - **2 pumps provide HHW to perimeter fin tube radiators and fan powered boxes**
- **Cooling**
  - **3 newly upgraded 700 ton electric chillers provide cooling to the building**
  - **4 CHW and 4 CW pumps both operate at constant volume**
  - **Plate & frame heat exchanger provides water-side free cooling**
  - **3 parallel operation 600 ton induced draft cooling towers fitted with VFDs reject heat for the building**
  - **An additional 3 cell 250 ton cooling tower supplies the tenant CW system**
  - **Tenant supplemental loop operates 24/7**
- **Ventilation**
  - **2 dedicated OA fans with VFDs supply outside air through a single riser to all floors, with balancing dampers at each floor.**
  - **Each floor AHU opens dampers fully when unit is in operation (no VAV boxes)**
  - **1 toilet exhaust fan serves bathrooms on all floors**

This building is being used to develop the template study, which has been made available to NYSERDA for review. Portions of the study are included in the initial draft to date, with other portions still under review by specific team members.

- Utility Analysis
  - Utility data has been collected and tabulated
  - Detailed analysis is underway
- Site Information Analysis
  - Building information collected including
    - Base building equipment and controls
    - Ventilation system description and current operation
    - AHU equipment information including coil size, capacity, and air flow
    - Basic tenant information
- Site Visits
  - Detailed site visit conducted reviewing general building information
  - Follow up site visit planned to review tenant spaces to determine optimal location for local IAQ equipment
    - Follow up site visit will review additional questions on building exhaust that arose during initial walk-through
- **Energy Analysis and Calculations**
  - **Preliminary energy analysis has begun for specific measures**
  - **More detailed energy analysis to follow the completion of further research and development**
- **Rough Draft**
  - **Draft report in development**
  - **Measures identified, and writing tasks distributed**
    - **Majority of measures have been drafted and added to report**
- Final Draft
  - Not yet begun

Large Midtown Manhattan Commercial Office Building #2

Large Midtown Manhattan Commercial Office Building #2 is a 46 story (46 floors at or above grade and 3 floors below) commercial office building in the Midtown neighborhood of Manhattan. The building was constructed in 1970. The building is typically fully occupied. The building has approximately 2,600 occupants during normal business hours of 8am to 8pm Monday through Friday. However, during the Covid-19 pandemic the building saw a reduced occupancy of about 5% (the building never closed). The current occupancy remains at about 5%. A total of four (4) interior air handling units and two (2) perimeter air handling units supply ventilation to the building. Additional units serve the lobby and first floor retail and restaurant tenants.

As part of this study, Goldman Copeland is reviewing actual current air distribution to the floors, as buildings of this vintage typically provide far more than current outdoor air requirements. For this reason, even without increasing outside air, the building could be achieving many of the benefits of added air distribution.

- Utility Analysis
  - Utility data has been collected and tabulated
  - Detailed analysis is underway
- Site Information Analysis
  - Building information collected including
    - Base building equipment and controls
    - Ventilation system description and current operation
    - AHU equipment information including coil size, capacity, and air flow
    - Basic tenant information
- Site Visits
  - Detailed site visit conducted reviewing general building information
  - Follow up site visit planned to review tenant spaces to determine optimal location for local IAQ equipment, in parallel to review of existing design drawings, as Goldman Copeland has been involved in the bulk of tenant fit-outs to date.
- Energy Analysis and Calculations
  - Energy analysis to follow further research and development
- Rough Draft
  - Draft report in development
  - Measures identified, and writing tasks distributed
    - Portion of measures have been completed and added to draft report
- Final Draft
  - Not yet begun

Large Midtown Manhattan Commercial Office Building #3

Large Midtown Manhattan Commercial Office Building #3 is a 26 story commercial office building with retail tenants on the ground floor. The building is located in the Midtown neighborhood of Manhattan. The building was constructed in 1954. The building is typically fully occupied. The building has approximately 2,000 occupants during normal business hours of 8am to 6pm Monday through Friday. However, during the Covid-19 pandemic the building saw a reduced occupancy of about 5% (the building never closed). The current occupancy remains at about 5%. Each floor has at least one air handling unit serving the interior space. The building has separate perimeter air handling units that supply ventilation to north, south, east, and west zones. The building is controlled by a New York Temperature Control Building Management System.

Further review of the base building air distribution system is necessary to better understand potential for integration with the various options, as the system is hybrid. Main air handling units distribute air to a portion of the building's floors, while other floors have dedicated AHUs. Solutions will likely vary depending on the air distribution system.

- Utility Analysis
    - Utility data has been collected and tabulated
    - Detailed analysis is underway
- Site Information Analysis
    - Building information collected including
        - Base building equipment and controls
        - Ventilation system description and current operation
        - AHU equipment information including coil size, capacity, and air flow
        - Basic tenant information
- Site Visits
    - Detailed site visit conducted reviewing general building information
    - Follow up site visit planned to further review current air distribution system, accounting for variance between the floors.
- Energy Analysis and Calculations
    - Energy analysis to follow further research and development
- Rough Draft
    - Draft report in development
    - Measures identified, and writing tasks distributed
        - Portion of measures have been completed and added to draft report
- Final Draft
    - Not yet begun

<u>Measures under review</u>

- **Upper Room UVGI**
    - **Three technologies for this option are under review**
    - **More detailed assessment will be available at next update**
    - **Preliminary assessment advises this as favorable solution in high-risk zones**
- **UVGI at coils in AHUs**
    - **Solution was in place on two floors at a Large Midtown Manhattan Commercial Office Building #1**
    - **Most studies suggest limited efficacy because of lack of transmission through AHU systems**
    - **High exposure requirements for constant flow sterilization may limit the efficiency of this measure**
- Increased outside air rates
    - Highly costly alternative from energy perspective

  - Measure discussions options to provide some limited OA increase rather than 100% OA or 24/7 OA
  - Limited safety improvement for cost
- Improved filtration at AHUs
  - Although transmission through AHU systems appears to be limited, this option is low cost both from an energy and a maintenance perspective, and provides other benefits
  - Depending upon current filter standard in place, is highly recommended by both ASHRAE and Goldman Copeland
- Improved controls, including IAQ monitoring, and adjustment of DCV set-points
  - Upgraded controls and sensors are available to measure multiple particulate parameters of indicator sizes, as well as local $CO_2$ levels
  - Measure is recommended for restoring occupant confidence, and providing a pathway to future energy savings
- Increased tenant visibility of ongoing IAQ
  - Detailed analysis of alternatives underway
  - Measure is recommended for restoring occupant confidence, and providing a pathway to future energy savings
- Local filtration options within tenant space
  - Local HEPA filters in common spaces and bathrooms
    - Appears that this measure would be presented as information to tenants, with action to be implemented by them if interested
  - Local air purifiers with filter in elevators
    - Recommended measure to reduce spread in highest risk area
- Retro-commission HVAC systems, with a focus on air-side testing and balancing
  - Low cost measure with significant ancillary benefits
  - Applicable at Large Midtown Manhattan Commercial Office Building #1 to determine current OA levels to better inform decision making
  - Applicable at Large Midtown Manhattan Commercial Office Building #2 to assess level of action already taken
- Confirm air flow through toilet exhaust system (possibly operate 24/7)
  - Large Midtown Manhattan Commercial Office Building #1 has limited efficacy at current toilet exhaust system, suggesting significant benefit
- Add humidification, with set-points varied based on OA temperature
  - Further review required before comment on this option – very costly from both an implementation and an energy intensity perspective
- **Treat AHU filters with MVTR-A1 Coating**
  - **Developing technology suggested by AEE board members**
  - **More analysis required to reach definitive conclusion – initial opinion would be favorable should results be verified – potential reduction in aerosol infiltration with little to no energy impact**

<u>Resource and guidance documents</u>

**A number of documents have been used in support of the preparation of these studies to date. Webinars and meetings of bodies including the AEE and ASHRAE have also been used, and will be referenced accordingly in the future. Note that while this bibliography contains studies referenced in the report thus far, additional sources are currently being reviewed for inclusion in the report. As details are added to the report, these sources will be added to the bibliography. The references are included below in *Appendix A*.**

Lessons Learned

A detailed analysis of air changes per hour (ACH) was conducted for Building #2, which demonstrated that design ACH for the building was approximately 2. With current operating protocols, this level was reduced to 1.5 ACH. Design standards for commercial office buildings are for higher ACH. But, this reflects specific fully occupied spaces rather than the building as a whole. These lower levels can be anticipated to be standard throughout, and should be considered in the OA related measures reviewed in the project.

**It has been found that transmission of COVID-19 is not typically through dispersed aerosolized particulate. As such, local measures focused on high risk spaces, such as upper room UV and local air purifiers will likely be more effective than significant ventilation investments. With that said, there are some measures still recommended for this system to both reduce dispersed infection chances and to improve the appeal of safety reopening office spaces. There are a few emerging technologies that are developing to minimize the risk of spreading COVID through HVAC systems, such as hydrophobic filter coatings and ionization filters. Of these, hydrophobic coatings are very promising; a definitive conclusion of this should be available following further research.**

**Seminars offered by the AEE and ASHRAE have proved beneficial for understanding the regulatory bodies' and other firms' positions on COVID mitigation measures. The majority of measures that these groups are putting forward align with those of Goldman Copeland, as detailed in our April position paper. However, with the development of the pandemic, new solutions have arisen, and will be correspondingly taken into account in the future report.**

Proposed Work Plan Adjustments

Based on current progress, and delays corresponding to coordinating NYSERDA protocols with building staff, the schedule for development of these projects will need to be extended. While additional review of technologies has been completed, the path to development of the full reports will likely be on a longer than originally intended timeline. We anticipate further review of technologies, particularly those related to Upper Room UVGI to extend further out, as we have not been satisfied with the data we have obtained to this point. We anticipate the following schedule moving forward:

- **Additional research – 3-4 weeks (complete 9/23)**
- **Adjust draft report and associated calculations accordingly – 3-4 weeks (complete 10/21)**
- **Review with clients and finalize – 2-3 weeks (complete 11/11**)

Next Steps

As expressed above, progress over the month of August was somewhat delayed, and the technology review process will be further extended. We have installed a prototype IAQ analysis monitoring system in our office space (installation was not within scope of this project). We will use this to monitor air conditions, and to add further detail into potential uses of this system both for energy optimization, and for improved air quality. We will schedule continued meetings with product vendors to better our understanding of all technologies.

Based on the above, the template report will be further flushed out. Goldman Copeland's initial white paper, dated from April of this year, will be updated to the current state of the art and incorporated into the introduction to the report. Initial detail on specific technologies, in particular upper room UVGI will be reviewed and incorporated. Further study will be completed on site to review specific requirements for installation of various measures. **Further review will likely require one additional week to finalize the sources. For the latter half of September, the findings from the research period will be compiled into the report, with the associated calculations and finalization of the report expected to be completed in October.**

Based on this review, Goldman Copeland will continue to develop basic scopes of work required for implementation of each measure, which will in turn provide the basis for estimating implementation costs. Simultaneous to this work, we will begin developing energy calculations to assess the energy impact of each of the measures.

Sincerely,

Tristan Schwartzman

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**Appendix A: UCGI Study References**

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*Ultraviolet C (UVC) Light System Installation*. TBL Building Sciences.

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