# DESIGN DEVELOPMENT STAGE ENERGY MODELLING REPORT

The Radiator Phase 2

340-342 Dufferin St
Toronto, ON

July 15, 2022
Revision: 0

Issued for:
Site Plan Approval

Issued to:
Hullmark

EQ Building Performance Inc. | 20 Floral Parkway, Concord, Ontario, L4K 4R1
416-645-1186 | www.eqbuilding.com

# Executive Summary

EQ Building Performance has created an energy model for The Radiator Phase 2 located at 340-342 Dufferin St in Toronto, ON for the purposes of Toronto Green Standard v4 Tier 1.

Table i indicates the project, as per the inputs described in this report and its appendices, is currently on track to meet the listed performance metrics of Toronto Green Standard v4 Tier 1, following the absolute targets compliance path.

***Table i - Savings Summary***

| Metric | Proposed Design | TGS v4 Tier 1 | Target Met? |
|---|---|---|---|
| Energy use Intensity (ekWh/m2) | 124.6 | 135 | YES |
| Greenhouse Gas Intensity (kgCO2e/m2) | 11 | 15 | YES |
| Thermal Demand Intensity (ekWh/m2) | 42.8 | 50 | YES |

The Key Energy Efficiency measures that contribute to this performance include:

- Ground source heat pumps
- Dedicated in-suite ERVs, minimum 75% effective
- Dedicated ERVs in amenity and commercial spaces, minimum 75% effective
- Average 20 cfm/suite corridor outdoor air
- Low flow plumbing fixtures - 6.6 LPM showers, 5.7 LPM kitchen and lav faucets
- Window to wall ratio of approximately 37%

A detailed list of energy model inputs and assumptions can be found in Appendix A.

# Table of Contents

# 1.0 Project Summary

The Radiator Phase 2 is a 11 storey Residential development located at 340-342 Dufferin St in Toronto, ON. The project consists of residential suites, associated amenities, flex space, and two levels of underground parking.

Key Characteristics of the energy model are shown in Table 1. An energy model rendering is shown in Figure 1.

***Table 1 - Key Energy Model Characteristics***

| | |
|---|---|
| Primary Use/Occupancy | Residential |
| Secondary Use/Occupancy | N/A |
| Project Stage | Site Plan Approval |
| Modelled GFA (m2) *excl. parking | 9,074 |
| Suite Count | 112 |
| Climate Zone | 5A |
| Weather File | Toronto City Centre CWEC 2020 |
| Key Schedules | Residential - NECB Schedule G |
| | Circulation - 24/7 |
| | Amenities - NECB Schedule B |
| | Retail - NECB Schedule C |

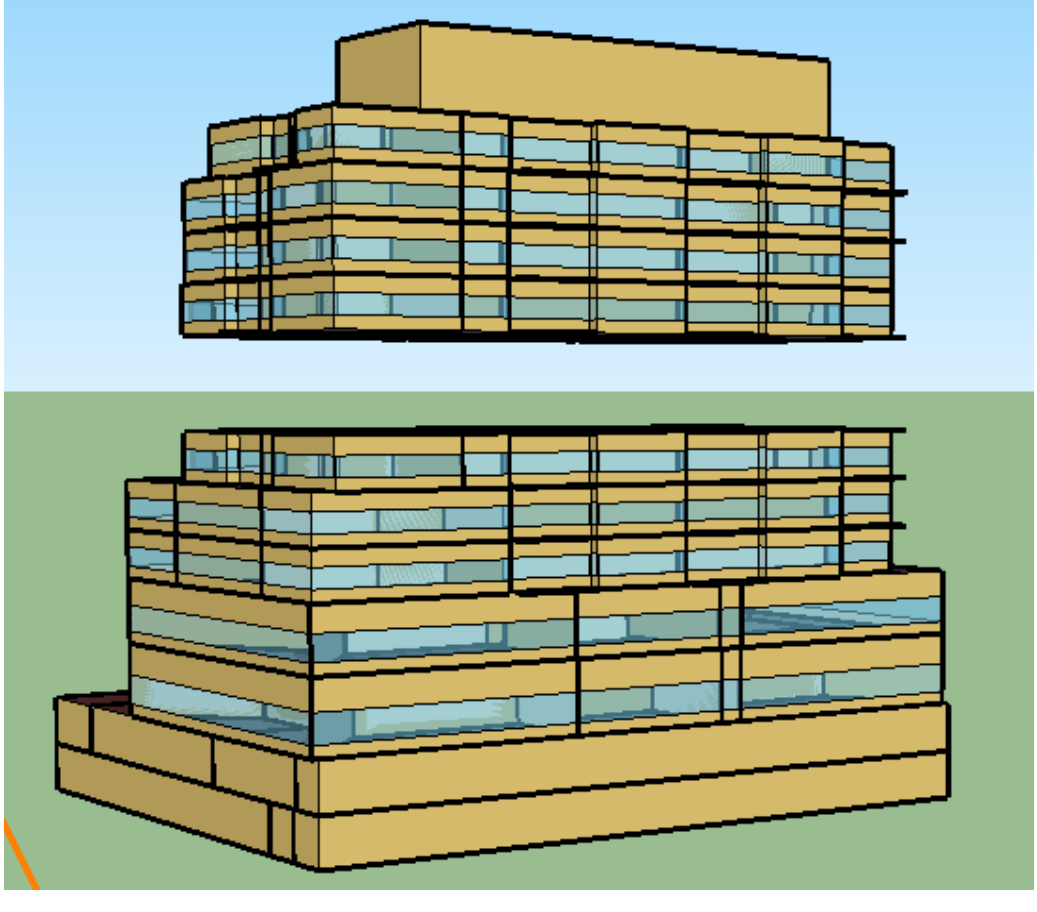

***Figure 1 - Energy Model Rendering***

## 2.0 Current Project Goals

The current energy efficiency and conservation goals relevant to the project are presented below. The intent of this report is to analyze only these goals, however it is noted that additional goals may become relevant at different stages depending on project requirements.

| | |
|---|---|
| **TGS v4 Tier 1** | Meet the Tier 1 absolute EUI (ekWh/m2), TEDI (ekWh/m2) and GHGI (kg CO2e/m2) targets. |

## 3.0 Background and Definitions

Building energy modelling provides a means to simulate building energy performance during the design stage of a project to quickly and effectively evaluate the impact of various design measures on building energy performance. In addition, building energy modelling allows the predicted building performance to be evaluated against key benchmarks such as the National Energy Code for Buildings (NECB), and ASHRAE 90.1.

The use of energy simulation software to validate energy efficient building design is recognized by programs such as the USGBC's LEED Rating System, Ontario Building Code SB-10, the Toronto Green Standard as well as various incentive and funding programs.

EQ Building Performance has been retained to assess the project's performance using energy modelling software, and to suggest design alternatives to achieve further energy savings where appropriate. Building performance can be assessed in a number of ways depending on the project goals, however are typically defined as one or more of the following:

| | |
|---|---|
| Energy Use **GJ**<br>Energy Use Intensity (EUI) **ekWh/m$^2$** | Annual energy use of the building. EUI is annual energy use divided by floor area. |
| GHG Emissions **kgCO2e**<br>GHG Intensity (GHGI) **kgCO2e/m$^2$** | Annual greenhouse gas (GHG) emissions produced by the building. GHGI is annual GHG emissions divided by floor area. GHG emission factors vary by fuel type and are often defined by the referenced standard. GHG emission factors are presented in Appendix A. |
| Thermal Energy Demand **GJ**<br>Thermal Demand Intensity (TEDI) **ekWh/m$^2$** | Annual space heating thermal demand of the building. TEDI is annual heating demand divided by floor area. Thermal demand is a passive metric, evaluating building enclosure and ventilation system performance while ignoring HVAC system efficiency. |
| Energy Cost **$**<br>Energy Cost Intensity (ECI) **$/m2** | Estimated annual energy cost of the building. ECI is energy cost divided by modelled gross floor area, not sellable area. Rates vary by utility (e.g. electricity vs natural gas) and are an estimate which should not be relied on for utility budgets. Utility rates used are presented in Appendix A. |
| Peak Electrical Demand **kW** | Peak monthly electricity demand of the building. |

## 4.0 Methods and References

The building was modelled using Energy Plus v9.3 energy simulation software. EnergyPlus is a widely-recognized hourly energy analysis program developed in collaboration with NREL, various US DOE National Laboratories, academic institutions, and private firms. Energy modelling was performed under the general techniques recognized in the following documents, where relevant and appropriate for the project:

- Energy Efficiency Report Submissions & modelling Guidelines For the Toronto Green Standard (TGS). City of Toronto Energy Efficiency Office (Feb 2019).
- Best Practice Guideline for Annual Energy Simulations for Large Buildings. Government of Ontario, Ministry of Municipal Affairs Building and Development Branch (May 2018).
- LEED v4 Reference Guide.

The following project specific documents were used to develop the energy model:

- Architectural drawings prepared by Sweeny & Co; dated July 15, 2022.
- Mechanical design brief prepared by Smith + Anderson; undated.
- Electrical design brief prepared by Smith + Anderson; undated.

Additional assumptions may have been used to fill in gaps in information, based on modelling experience and knowledge of building systems.

## 5.0 Results Summary

A summary of the proposed building design performance as it relates to the current project goals can be see in Table 2.

***Table 2 - Energy Model Performance Summary***

| Metric | Proposed Design | TGS v4 Tier 1 | Target Met? |
|---|---|---|---|
| Energy use Intensity (ekWh/m2) | **124.6** | **135.0** | **YES** |
| Greenhouse Gas Intensity (kgCO2e/m2) | **11.0** | **15.0** | **YES** |
| Thermal Demand Intensity (ekWh/m2) | **42.8** | **50.0** | **YES** |

Table 2 indicates the project, as described in this report and its appendices, is currently on track to meet the listed performance metrics of Toronto Green Standard v4 Tier 1. A detailed list of energy model inputs and assumptions can be found in Appendix A, however the key energy efficiency measures that contribute to this performance include:

- Ground source heat pumps
- Dedicated in-suite ERVs, minimum 75% effective
- Dedicated ERVs in amenity and commercial spaces, minimum 75% effective
- Average 20 cfm/suite corridor outdoor air
- Low flow plumbing fixtures - 6.6 LPM showers, 5.7 LPM kitchen and lav faucets
- Window to wall ratio of approximately 37%

## 6.0 Detailed Results and End Use Breakdown

An end use breakdown of the results can be seen in Table 3 and Figure 2, and a detailed list of energy model inputs and assumptions can be found in Appendix A.

*Table 3 - Detailed Results Breakdown*

| End Use | Proposed Design | | Intensity | |
|---|---|---|---|---|
| | Electricity (GJ) | Natural Gas (GJ) | | |
| Interior Lighting | 862 | 0 | 26.4 | ekWh/m2 |
| Misc Eqp. / Plug Loads | 749 | 0 | 22.9 | ekWh/m2 |
| Heating | 342 | 529 | 26.6 | ekWh/m2 |
| Cooling | 224 | 0 | 6.9 | ekWh/m2 |
| Pumps | 3 | 0 | 0.1 | ekWh/m2 |
| Fans | 287 | 0 | 8.8 | ekWh/m2 |
| Domestic HW | 0 | 1,049 | 32.1 | ekWh/m2 |
| Exterior Lighting | 26 | 0 | 0.8 | ekWh/m2 |
| **Annual Energy (GJ) / EUI** | **4,072** | | **124.6** | **ekWh/m2** |
| **Annual GHG Emissions (kg CO2e) / GHGI** | **100,027** | | **11.0** | **kgCO2e/m2** |
| **Annual Energy Cost ($) / ECI** | **$96,968** | | **$12.15** | **$/m2** |
| **Annual Thermal Demand (GJ) / TEDI** | **1,398** | | **42.8** | **ekWh/m2** |

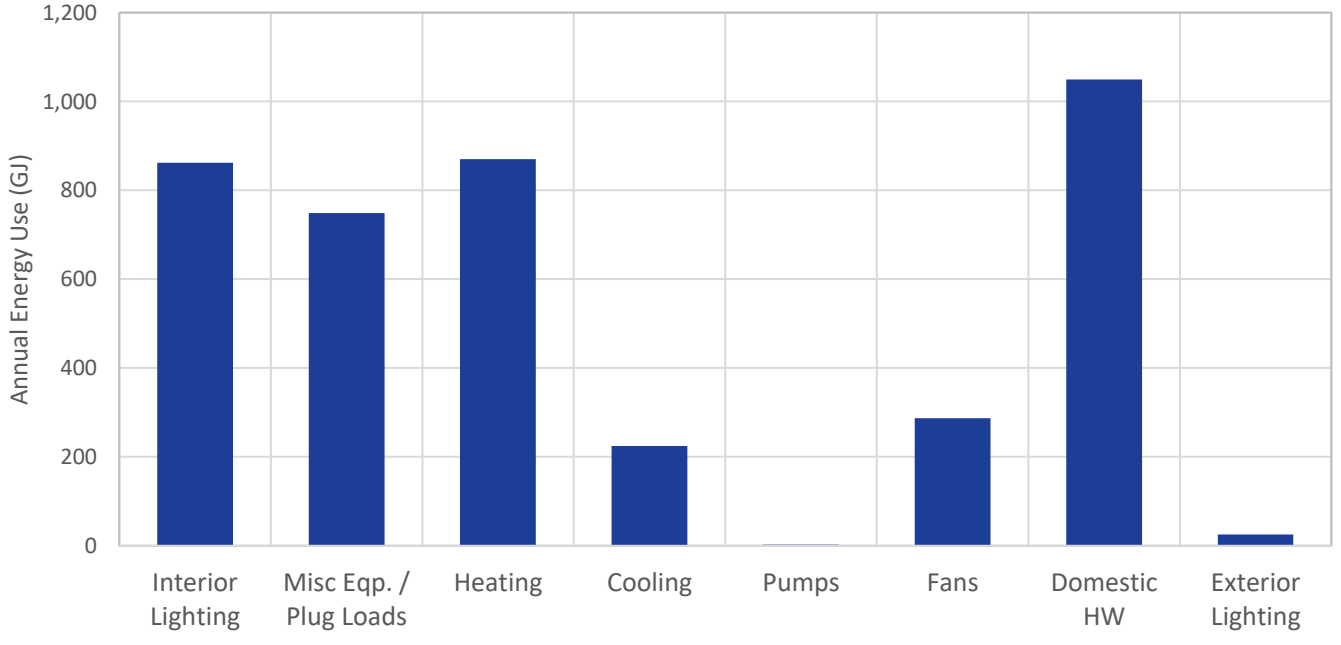


*Figure 2 - Annual Energy End Use Breakdown (GJ)*

Figure 3 demonstrates how the building performs in relation to Tiers 1 through 3 of version 4 of the Toronto Green Standard, in terms of the two absolute performance metrics - Energy Use Intensity (EUI) and Greenhouse Gas Intensity (GHGI). For context, Tier 3 is meant to represent a Net-Zero Ready or Passive House level of building performance.

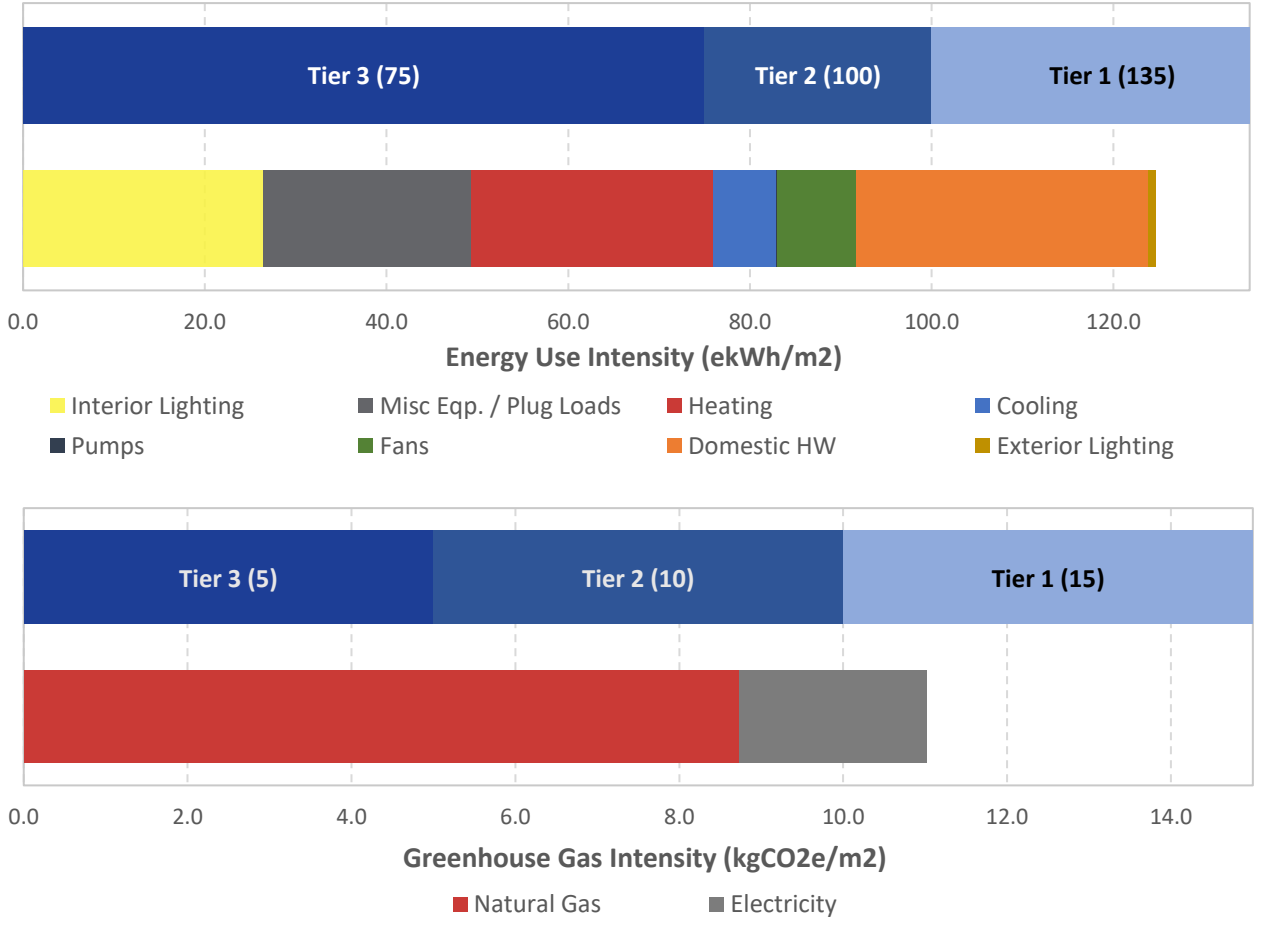


***Figure 3 - Annual EUI, GHGI and TEDI and Comparison to TGS Metrics***

Figure 4 shows a breakdown of annual *Energy Use* , annual *Energy Cost* and annual *GHG Emissions* by utility. This demonstrates the importance of utility type to each metric and can assist project teams in focusing any further efforts depending on project efficiency goals. GHG emission factors and energy cost rates are presented in Appendix A.

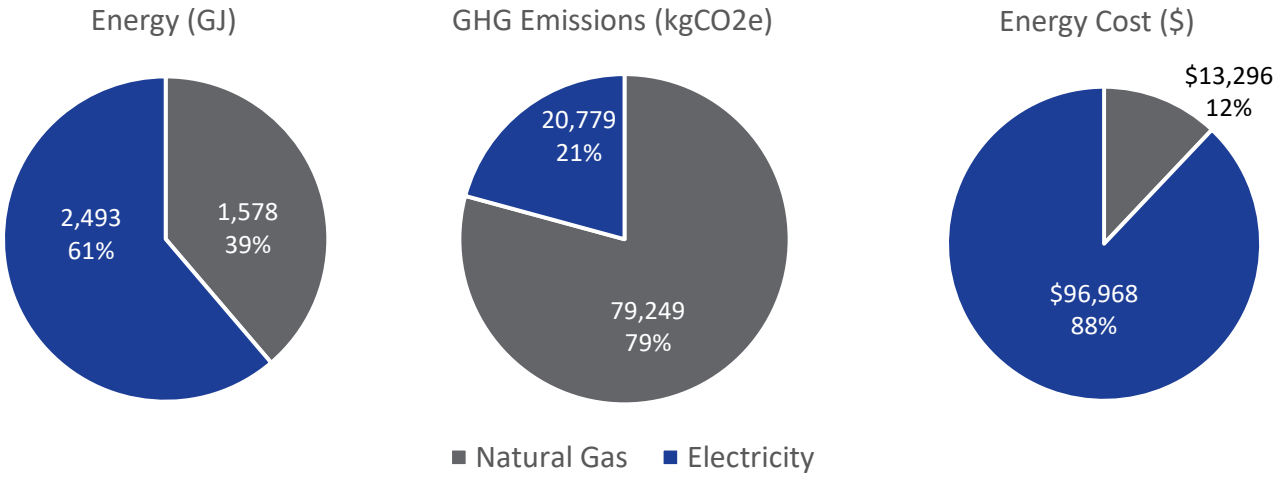


***Figure 4 - Annual Energy (GJ), GHG Emissions (kgCO2e) and Energy Cost ($) by Utility***

## 7.0 Disclaimer and Next Steps

A detailed list of model inputs are provided in Appendix A. The ability of a building design to achieve the stated project goals remains the responsibility of the design team. The design team should review the report and appendices to ensure all inputs and assumptions are accurate, or represent a conservative estimate of performance.

In addition, the architect, mechanical and electrical engineer must ensure any mandatory requirements of the energy code referenced are met with the building design. If relevant, mandatory requirements checklists will be provided by EQ Building Performance alongside this report, which must be filled in and signed by the design team.

Please don't hesitate to contact EQ Building Performance with any questions or comments regarding the energy modelling of this project.

**Prepared by:**

**Sheriza Jiwani, B.A.Sc., EIT**
Energy Analyst
sjiwani@eqbuilding.com

**Samantha Menard, B. Arch. Sci., CET, LEED AP BD+C**
Energy Team Manager
smenard@eqbuilding.com

# Appendix A - Model Inputs and Assumptions

The characteristics of the proposed and reference models, as applicable, are listed below:

| Input | Proposed Design | Notes |
|---|---|---|
| **Weather File** | Toronto City Centre CWEC 2020 | |
| **Climate Zone** | 5A | |
| **Building Enclosure** | | |
| **Steel Framed Wall** | **Precast Wall/Masonry**<br>50 mm continuous insulation (R-8)<br>89 mm batt insulation between steel studs (R-14)<br>***Nominal R-22, Effective R-13.9***<br><br>*Thermal bridging accounting for:*<br>- Slab edges, balconies & terraces<br>- Corners<br>- Glazing transitions<br>- Parapets<br><br>**Overall Effective R-7.5** | Thermal bridging estimated using BC Hydro Building Envelope Thermal Bridging Guide, per TGS Modelling Rules. |
| **Roof** | 200 mm continuous insulation on concrete deck<br><br>**Effective R-33.2** | |
| **Glazing** | Dual IGU, low-e coating, argon fill, aluminum framing warm edge spacer.<br><br>**U-0.35, SHGC-0.35** | |
| **Window Wall Ratio** | Overall: 37.0% | Incl. mechanical penthouse |
| **Infiltration Rate** | 0.25 L/s/m$^2$ at 5Pa, per TGS v3 modeling rules. No credit taken for reduced infiltration rate. | |
| **Electrical Loads** | | |
| **Interior Lights** | Per Reference:<br>Suites 5 W/m2<br>Corridors 7.1 W/m2<br>Stairway 6.24 W/m2<br>Parking Garage 1.51 W/m2<br>Office - Open Plan 8.72 W/m2<br>Amenity 11.51 W/m2<br>Lobby 10.76 W/m2<br><br>**Overall: 4.7 W/m2** | |

| Input | Proposed Design | Notes |
|---|---|---|
| **General Plug Loads** | Per Reference:<br>Suites 5 W/m2<br>Corridors 0 W/m2<br>Stairway 0 W/m2<br>Parking Garage 0 W/m2<br>Office - Open Plan 16.2 W/m2<br>Amenity 1 W/m2<br>Lobby 1 W/m2<br><br>**Overall: 3.0 W/m2** | |
| **Exterior Lights** | Per Design:<br>Total: 1.64 kW | |
| **Additional Misc / Process Loads** | Additional energy use estimated for:<br>Parking Garage Fans<br>Misc. Common Fans and Pumps<br>Domestic Cold Water Booster Pumps (VFD)<br>Elevators | |
| **HVAC Plant** | | |
| **Heating Plant** | 95% condensing boilers serving HW coils<br>Loop temp: 160F / 40F delta T<br>Outdoor air reset on loop<br>Variable speed pumps / 2 way valves | |
| **Heat Pump Loop** | Geo-Exchange System<br>24 x 60' Boreholes<br>70% Propylene Glycol Mixture<br><br>Variable Speed Pumps: 75ft head<br>> Estimated 22 W/gpm power | |
| **HVAC Systems** | | |
| **In Suite** | **Ground Source Heat Pump**<br><br>**DX Heating**: COP-3.4<br>**DX Cooling:** COP-4.7<br>**Fans:** EC motors - 0.3 W/cfm<br><br>**Ventilation:** Provided by In-suite ERVs<br>> 75% sensible effectiveness.<br>> Total 1 W/cfm fan power | |

| Input | Proposed Design | Notes |
|---|---|---|
| **Corridors** | **Corridor AHU**<br><br>**Heating:** Served by HW loop<br>**DX Cooling:** COP-3.4<br>**Fans:** Estimated 1 W/cfm<br><br>**Ventilation:** 100% OA System,<br>serves other spaces as noted | |
| **Amenities** | **Ground Source Heat Pump**<br><br>**DX Heating**: COP-3.4<br>**DX Cooling:** COP-4.7<br>**Fans:** EC motors - 0.3 W/cfm<br><br>**Ventilation:** Provided by dedicated ERVs<br>> 75% sensible effectiveness.<br>> Total 1 W/cfm fan power | |
| **Lobby** | **Ground Source Heat Pump**<br><br>**DX Heating**: COP-3.4<br>**DX Cooling:** COP-4.7<br>**Fans:** EC motors - 0.3 W/cfm<br>**Ventilation:** Provided by Corridor AHU | |
| **Office/Flex Space** | **Ground Source Heat Pump**<br><br>**DX Heating**: COP-4.7<br>**DX Cooling:** COP-3.4<br>**Fans:** EC motors - 0.3 W/cfm<br><br>**Ventilation:** Provided by dedicated ERVs<br>> 75% sensible effectiveness.<br>> Total 1 W/cfm fan power | |
| **Ventilation** | Per design:<br>Corridor AHU(s): 20 cfm/door average flow<br>Suites: 53 cfm/ERV average flow<br>Amenities: per ASHRAE 62.1-2007<br>**Total:** **9,700 cfm** | |

| Input | Proposed Design | Notes |
|---|---|---|
| **Domestic Hot Water** | | |
| **Hot Water Plant** | 95% condensing boilers / DHW heaters | |
| **Plumbing Fixtures** | Low Flow per Design:<br>Showerheads: 6.6 LPM (1.8 GPM)<br>Lav Faucets: 5.7 LPM (1.5 GPM)<br>Kitchen Sinks: 5.7 LPM (1.5 GPM) | |
| **Utility Rates** | | |
| **Electricity** | Assumed, per current market prices:<br>0.14 $/kWh | |
| **Natural Gas** | Assumed, per current market prices:<br>0.32 $/m3 | |
| **Greenhouse Gas Emissions Factors** | | |
| **Electricity** | Per OBC SB-10, Table 1.1.2.2:<br>0.030 kgCo2e/kWh | |
| **Natural Gas** | Per National Inventory Report:<br>1.899 kgCO2e/m3 | |