Appendix: Consultant Scope of Work

Building Energy Consultant

The primary objective of the Building Energy Consultant is to recommend and support design decisions related to building performance using computer simulation and engineering judgement.

Abbreviations

- ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineer)
- BEMP (Building Energy Modeling Professional)
- ECM (Energy Conservation Measure)
- NECB (National Energy Code of Canada for Buildings)
- LEED (Leadership in Energy and Environmental Design)
- OPR (Owner's Project Requirements)
- SBP (Sustainable Building Policy)
- SBGD (Sustainable Building Guidance Document)

Qualifications

Professional Qualifications

The Building Energy Consultant team lead must have at least five years of experience in energy modeling and shall be a Professional Engineer with APEGA, as The City may request that modeling reports be sealed. Other beneficial accreditations include ASHRAE's BEMP credential.

Energy Modeling Software

All energy modeling is to be completed using a capable hourly simulation program, approved for NECB and LEED submissions. EE4 as a stand-alone tool will not be permitted, as it severely limits the type of options that can be directly explored. Note that software selection shall not be a limitation in exploring any measure, system or technology deemed appropriate by The City and the design team. The design team shall include at a minimum, The City Project Manager, SBP Steward, the Architect, Structural/Building Envelope engineer, Mechanical engineer, and Electrical engineer. The consultant shall use whatever tools necessary to provide accurate feedback on building performance as necessary according to the detailed scope identified below.

Requirements

The scope of services of the Building Energy Consultant shall include, but are not limited to, the following requirements.

General Requiments

The scope of services of the Building Energy Consultant shall be completed in accordance with guidelines set out in ASHRAE Standard 209, LEED Minimum Energy Performance prerequisite and Optimize Energy Performance credit. The design phases shall be drafted following the modeling cycles in ASHRAE 209 and as deemed appropriate for the specific project. Items of particular importance to The City are provided below. The following list includes minimum requirements and shall not be considered comprehensive:

- The Building Energy Consultant shall complete all the required documentation to show compliance with applicable green building certifications (i.e., LEED), The City's SBP Minimum Sustainability Performance Requirements, and NECB, as required by the Alberta Building Code.
- The Building Energy Consultant shall be onboarded at the same time as the core design team. During the pre-design stage, the project team shall discuss and identify energy related goals and targets for the project. These goals and targets shall be documented in the OPR.
- The Building Energy Consultant shall work closely with the Architect to assess the impact of proposed massing and layout options being evaluated for the project. It is suggested that at least three massing options be assessed for each project. Impacts and results for each option shall be summarized in a report.
- An energy modeling summary report and/or update shall be provided at each major design milestone defined by the project. A final report shall be issued to reflect as-built drawings at occupancy (if any changes occurred during construction; check with the construction team).
- An energy modeling workshop (aka energy charrette) shall be scheduled during the Schematic Design (SD) phase and shall happen no later than the release of the Design Development (DD) documents. See below for specific requirements.
- The workshop and early energy modeling reports (SD & DD minimum) shall develop and present a detailed list of ECMs, ideally presented as a parametric analysis.
    - The ECMs shall be a mix of innovative solutions, including those deemed unconventional, and feasible design options that are developed with the project team. Refer to ASHRAE 189.1, the Low TEDI guide, the SBGD, and other relevant resources for potential lists of ECMs.
    - ECMs shall not be limited to achieving the minimum performance levels noted in the SBGD.
    - ECMs shall support The City's ultimate climate goal of achieving net zero by 2050.
- Achieving carbon and energy optimization shall be prioritized in the following order:
    - Energy conservation: maximize passive design and use energy only when needed.
    - Energy efficiency: the utilization and selection of efficient equipment and technology.
    - Renewable and on-site energy generation.
    - Renewable Energy Credits (RECs).
    - Carbon offsets.

Energy Modeling Workshop Requirements

An energy modeling parametric analysis can play a pivotal role in supporting the integrated design and performance modeling of various components or systems. It is essential to conduct modeling that evaluates not only each proposed ECM in isolation but also adopts a holistic approach to assess their combined impact. The result of the workshop shall be, in agreement with the design team, to solidify a proposed design pathway that meets the project's specified requirements and sustainability objectives.

At the workshop, the minimum attendance shall include representatives from the Architectural, Mechanical, Electrical, and Building Envelope disciplines, alongside the City Project Manager and the SBP Steward.

Building systems to be evaluated at this stage include, but are not limited to, the following:

- Massing energy analysis of at least three options.
- Wall, roof, and floor performance based on effective R-values, considering heat loss from not only assemblies, but also interface details. This is referenced in The Building Envelope Thermal Bridging Guide (located at www.bchyrdro.com/thermalguide).
- Fenestration performance, based on solar heat gain coefficient, visible transmittance, and overall U-value (including framing) and including building geometry, orientation, and shading impact.
- Infiltration options showing air leakage improvements up to Passive House requirements.
- Lighting power density ranges, as appropriate, but no less than two levels.
- Daylight potential and excessive illuminance levels (i.e., glare) in zones of interest.

- A minimum of two mechanical system types (e.g., air-based heating and cooling with recirculation vs. 100% outdoor air with radiant heating).
- A minimum of two heating plant system options (e.g., condensing boiler, air or ground source heat pumps, variable refrigerant flow heat pumps). Explore connections with service water heating systems.
- If the building is not proposing cooling, include a design option that would include cooling to show the impact.
- Varying conventional and improved options for fans, equipment efficiencies, COPs, heat recovery, etc.
- Impact of potential renewable energy options. A minimum of one design option shall be explored by the design team, including solar photovoltaics.
- Building-type specific energy consumption, conservation, or generation measures (e.g., cogeneration systems, district heating, chiller heat recovery for data centre spaces or specialized refrigeration such as ice rinks, innovative dehumidification and reheat strategies in swimming pools, etc.).

Energy Units and Rates

Prior to starting energy related analysis on a project, the Building Energy Consultant must contact a SBP Steward and request City utility rates and emission factors that will be used in the assessment. Any information provided by the Steward is confidential and is not to be distributed outside the project team.

All energy related evaluations shall be reported in the following metric units:

- Electricity: kWh/year
- Natural Gas: GJ/year
- Total Energy: ekWh/year
- Energy Use Intensity (EUI): ekWh/m^2/yr
- Thermal Energy Demand Intensity (TEDI): ekWh/m^2/yr
- Cooling Demand Intensity (CEDI): ekWh/m^2/yr
- Building Peak Electrical Demand: kW
- Greenhouse Gas Emissions (GHG): tonnes CO2e/yr
- Greenhouse Gas Emissions Intensity (GHGI): tonnes CO2e/m^2/yr

Data Reporting Requirements

For each modeling cycle/deliverable, at a minimum, provide the following energy model input information:

- Project description, including name, location and weather station name and type.
- Modeling software used.
- Building floor area by space type or zone.
- Internal loads and schedules by space type or zone, including occupancy, lighting, equipment, service hot water, thermostat setpoints, etc.
- Other relevant information use to calculate outputs, including utility rates, GHG emission factors, etc.
- Building envelope parameters, including both nominal and effective R-values, fenestration effective U-values, window-to-wall ratios, solar heat gain coefficients, infiltration rates, etc.
- Mechanical equipment efficiencies, including boiler efficiencies, chiller COPs, heat pump COPs, gas fired equipment COPs, fan and pump static pressures and efficiencies, motor efficiencies, VFDs, the presence of heat recovery and heat recovery efficiency.
- For the reference building, include the values used in the model, along with the specific reference in the code.
- Information on controls including plant and system level setpoints.
- All relevant information for renewable energy systems.

For each modeling cycle/deliverable, at a minimum, provide the following energy model output information:

- Relative energy use, energy cost, and GHG emissions broken down by end uses, including but not limited to, heating, cooling, lighting, equipment, fans, heat recovery, humidification, and pumps.
- Relative peak heating and cooling loads, and energy demand for the building and for the worst performing zones.
- Energy consumption comparison table with reference building for design pathways, including consumption breakdown by fuel type.
- EUI, TEDI, CEDI, GHGI, % energy, % energy cost, and % GHG savings compared to the reference building, for proposed design pathways.
- Anticipated onsite renewable energy production potential (energy, cost savings and avoided emissions).
- For projects pursuing green building certification, report on the anticipated result (e.g., number of points achievable under the LEED Optimize Energy Performance credit).
- Provide at least two recommended design pathways that meet the energy, energy cost and GHG requirements. Include at least one conventional system selection and one "low carbon" design option.
- Document decision justifications and recommendation made during the earlier stages in each updated report.
- All outputs shall be reported using the metric units provided above.

Deliverables

- Provide Energy Modeling Summary Reports for each modeling cycle (that meets the requirements outlined in the "Data Reporting Requirements" section above. At minimum, a preliminary report shall be provided at SD, an updated report at DD, and a final report at Contract Document (CD) phase.
- All submission requirements for compliance with NECB, as required by the Alberta Building Code.
- All submission requirements to show compliance with project's pursued green building certifications, depending on applicability this may include LEED, ZCB, WELL, etc.
- In compliance with the City of Calgary's Master Consulting Terms & Conditions, all reports, discussion summaries, meeting minutes, and modeling files will be provided to The City of Calgary's Project Manager, and SBP Steward in electronic format.

References

- Advanced Energy Modeling for LEED v2, U.S. Green Building Council, 2011
- ASHRAE Standard 209: Energy Simulation Aided Design for Buildings except Low Rise Residential Buildings, ASHRAE, 2018
- ASHRAE Standard 189.1: Standard for the Design of High-Performance Green Buildings, ASHRAE, 2020
- ASHRAE Standard 90.1: Energy Standard for Buildings except Low-Rise Residential Buildings, ASHRAE, 2016
- ASHRAE Handbook of Fundamentals, ASHRAE, 2013
- Building Envelope Thermal Bridging Guide Version 1.6, BC Hydro, 2021
- Design Version 3 Energy Modelling Guidelines, Zero Carbon Building, 2022
- Energy Modeling Guidelines v2, City of Vancouver, 2018
- Guidance for Energy Modeling Compliance Documentation in LEED Canada, 2015
- Guide to Low Thermal Energy Demand in Large Buildings, BC Housing, 2018
- LEED v4 Reference Guide, U.S. Green Building Council, 2017
- LEED v4.1 Reference Guide, U.S. Green Building Council, 2019
- Multifamily Energy Modeling Guidance v4, U.S. Green Building Council, 2017
- National Energy Code of Canada for Buildings, National Research Council Canada, 2020