Renewable Energy Feasibility Study Requirements for City Agencies, Corporations & Divisions

Where technically and financially practical, all new facilities and additions with a gross floor area greater than 100 m^2 shall install on-site renewable energy devices to generate the equivalent of at least 5% of the building's energy modelled annual energy consumption or 20% if using geo-exchange systems[1].

To determine financial feasibility, a business case should be prepared which demonstrates that the project will generate energy savings sufficient to offset a debt service schedule over the performance life of the asset (but no more than twenty years), inclusive of all financing costs (EED staff will provide current discount rates as well as hydro and other utility rates and escalation to be used in the study). The available incentives are to be included in the calculations.

The baseline for the business case shall be the incremental design and installation costs of the renewable energy system vs. a conventional system.

Renewable energy technologies generally acceptable include solar PV and solar thermal, wind and geo-exchange systems. Site-specific conditions may limit those options and are to be addressed in the feasibility study.

At minimum, the feasibility study shall incorporate the following components:

A. Ground Source and Air Source Heat Pump Feasibility Study

1. Building and site assessment

    - The consultant shall review drawings, design parameters, BAS capabilities, proposed HVAC systems and proposed borefield location to verify that ground source (GSHP) and/or air source heat pump system (ASHP) is appropriate for the site.
    - Consultant shall work with a local driller and review the Ontario Geological Survey (OGS) data to estimate the ground thermal conductivity. *A test borehole is not required at the feasibility stage, however Thermal Conductivity Test is mandatory during detailed design if the decision has been made to move forward with the system.*
    - Consultant shall make a reasonable effort to identify any issues with drilling at the proposed location.
    - Consultant shall describe the proposed system, including the system size, location and sizing of vertical/horizontal geoexchange field, building connection point, heat pump configuration, and sequence of controls.

[1] Where a renewable energy installation is technically practical and meets the financial criteria, but cannot technically achieve the full energy threshold, an exemption may be granted for the shortfall.

2. Building energy model

- Based on available design, drawings and information provided by City of Toronto, consultant shall create an 8760 hour room-by-room energy model (the same building energy model can be used for this feasibility study and for general building design).
- Consultant shall use the building energy model and GHX model to directly inform design and consider all relevant opportunities that may promote system balancing. This may include incorporating DHW load, ventilation loads, fluid cooler, snow melting, other building exterior or interior changes, hybrid system, etc. The report shall clearly indicate which options were considered and the corresponding results.
- Relevant screen shots illustrating results from building energy model shall be included in the report.
- Consultant shall indicate a preferred system configuration and demonstrate that it is balanced.

3. GHX model/design/sizing

- GHX sizing shall not be based on rules of thumb.
- GHX sizing shall be done with GLD, Earth Energy Designer (EED) or Looplink.
- Consultant shall include a plot illustrating 20-year ground temperature changes.
- Consultant shall explicitly state annual heat flows to and from the ground.
- Consultants shall provide a layout for the proposed borefield.
- Relevant screen shots illustrating results from GHX model shall be included in the report.

4. Energy/Financial/GHG Analysis

- The Consultant shall evaluate the energy, cost, and GHG savings of a GSHP and compare them against an ASHP and a reasonable conventional system.
- Financial analysis shall include net present value (NPV) over 20 and 50 year evaluation periods using a discount rate provided by the City, return on investment (ROI), and simple payback calculations for GSHP and ASHP over the conventional system. Please note that consultant is expected to identify and run an analysis on the incremental costs of using GSHP or ASHP over a conventional system.
- Identify applicable utility and/or government incentives.
- Use utility rates provided by the City in the financial analysis but also evaluate other possible scenarios that may occur as a sensitivity analysis, for example, financial performance using the highest historical gas rate in the past 10 years.
- As separate line items, consultant shall consider savings from (if applicable):
    i. cooling season energy costs;
    ii. heating season energy costs;
    iii. saved person-hours for operation and maintenance of mechanicals;
    iv. saved person-hours and materials for other building operations (snow-melting);
    v. saved water usage and chemical treatment (cooling towers);
    vi. saved infrastructure cost (new builds); and
    vii. capital reserve savings due to longer component lifetimes (based on ASHRAE life expectancy).
- Consultant shall refer to AHRI-rated specifications of proposed equipment to estimate equipment efficiencies. Efficiency values shall be adjusted to represent

expected operating conditions (for example, entering or leaving water temperatures that deviate significantly from rated performance points) and the adjustment should be justified within the report.
- Components costs should be traceable and included as separate line items; acceptable sources include either RS means mechanical data and actual equipment quotes for this project or from recent previous projects.
- Consultant shall estimate GHG savings for both GSHP and ASHP options based on current emission factors to be provided by the City. If not provided, consultant shall use emission factors for Ontario as reported in the National Inventory Report.

5. Environmental Impact

    - Identify any potential ground loop impacts on the local water source and the environment (if any).

6. Report

    - Provide a detailed report which clearly indicates/describes methodologies, parameter assumptions (and sources) and findings, to such a degree that City staff can verify all requirements have been met.
    - Model files and data inputs used to support the analysis should be provided with the report.

B. Solar PV and Solar Thermal Analysis

As part of the scope of work, the Vendor is to

- Conduct the feasibility study on solar system installation (both PV and thermal) on the roof and walls of the building, windows (Building-Integrated solar PV - BIPV) and the grounds, for example solar carport over the parking lot/garage.
- Conduct a long-term shading study incorporating existing *and* permitted building heights and other obstructions to the south-east, south and south-west of the site.
- Provide an estimate of the maximum PV system size, and system production using accepted industry solar PV design software (PVSyst and Helioscope are preferred) and provide that software report as an attachment to the study.
- Provide preliminary layout of the potential system taking into account the set-back from the property edge and shading (for ground systems) and roof edges, mechanical equipment, and green roof requirements (for roof based systems).
- Conduct GHG savings analysis.
- Provide financial analysis including net present value (NPV), return on investment (ROI), and payback calculations (including financing costs) based on current hydro rates for net metering. The City EED staff will provide the necessary electricity rates and discount rates to be used for calculations. Please provide a spreadsheet with the analysis in the attachment to the study.

C. Solar Ready

Where the business case for a renewable energy system does not meet financial criteria, but solar system is technically practical, the building must be designed and built to accommodate a solar installation in the future.

The roof should be designed to be structurally capable of accommodating additional dead and live loads of a solar PV system, which typically adds 3-6 lbs. /sq. ft. It should be free of obstructions such as self-shading on the south facing portion e.g. from rooftop units, to maximize sun exposure. The designer should include roof loads, and potential location of solar PV system into roof plan tender drawings.

Required to incorporate "solar ready" principles. At a minimum, this means:

1) Designating the area of the roof for future solar PV and making it structurally sound to support it
2) Place HVAC or other rooftop equipment on the north side of the roof, to prevent future shading
3) Provide a conduit from the roof to the rough in for the location of the external disconnect (exact location to be determined in discussions with Toronto Hydro) and then to closest electrical panel that the solar system is able to connect to. Size of conduit to be determined based on maximum potential PV system size.
4) Provide one inch conduit for communications from the roof to building electrical connection point or to the network hub (exact location to be determined based on monitoring requirements during design stage)

-- END OF TERMS OF REFERENCE --